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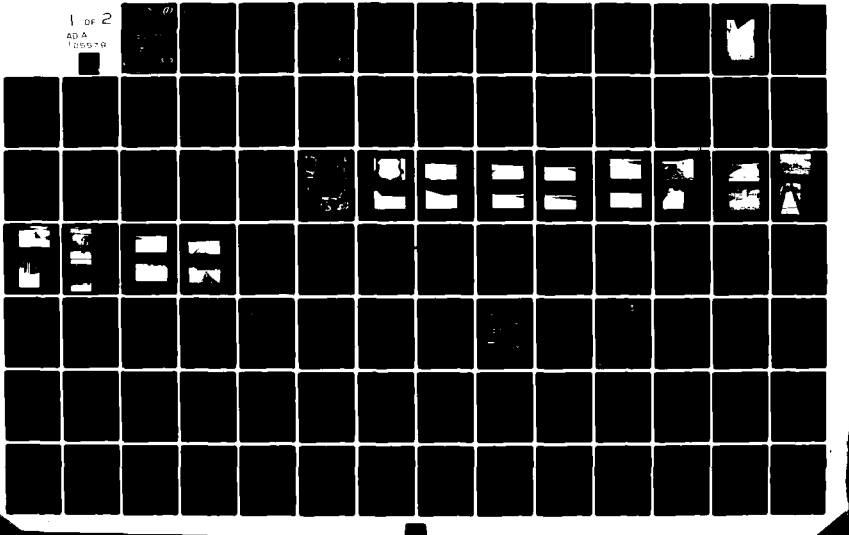

LEVEL II

GRAND-CHARITON BASIN

GRINDSTONE-LOST-MUDDY CREEK DAM C-3

DEKALB COUNTY, MISSOURI

MO. 10384

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE, 1980

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

GRINDSTONE-LOST-MUDDY CREEK DAM C-3
DEKALB COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. MO 10384

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE, 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Grindstone-Lost-Muddy Creek Dam C-3 Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Grindstone-Lost-Muddy Creek Dam C-3 (MO 10384).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50% of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 25 SEP 1980
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 25 SEP 1980
Colonel, CE, District Engineer — Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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Division II	Soils Report, USDA-SCS, May, 1968
Division III	Engineer's Report, USDA-SCS, May, 1968

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Grindstone-Lost-Muddy Creek Dam C-3
State Located	Missouri
County Located	Dekalb County
Stream	Lost Creek
Date of Inspection	June 3, 1980

Grindstone-Lost-Muddy Creek Dam C-3 was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Grindstone-Lost-Muddy Creek Dam C-3 has a height of thirty-nine (39) feet and a storage capacity at the minimum top elevation of the dam of eight thousand nine hundred and sixteen (8,916) acre-feet. In accordance with the guidelines, an intermediate size dam has a height greater than or equal to forty (40) feet but less than one hundred (100) feet and a storage capacity greater than or equal to one thousand (1000) acre-feet but less than fifty-thousand (50,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Grindstone-Lost-Muddy Creek Dam C-3 is classified as an intermediate size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends about fifteen miles downstream of the dam. Within the damage zone are one dwelling with barns and State Highway A at 9.8 miles; a dwelling and barns at 12.5 miles; a dwelling and barns at 12.8 miles; a railroad at 13.8 miles and two trailer houses at 15 miles downstream.

Our inspection and evaluation indicates that the spillways do not meet the criteria set forth in the recommended guidelines for an intermediate size dam having a high hazard potential. The Probable Maximum Flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (1% probability flood, a flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 35% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Based on available design data and on the observations made during the field inspection of the dam, the following recommendations are made:

a. The emergency spillway size and/or the height of the dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

b. The joint openings in the concrete spillway outlet should be repaired.

c. Tree growth on the upstream side slope should be removed and measures taken to prevent recurrence. Large trees or trees with an extensive system of roots should be removed under the guidance of an engineer experienced in the design and construction of dams.

d. Periodic inspection of the dam should be continued with inspection reports made a part of the records of this structure.

Rey S. Decker
E-3703

Gordon Jamison

Gordon Jamison

Harold Ulmer

Harold Ulmer
E-19246

H. P. Hoskins

Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

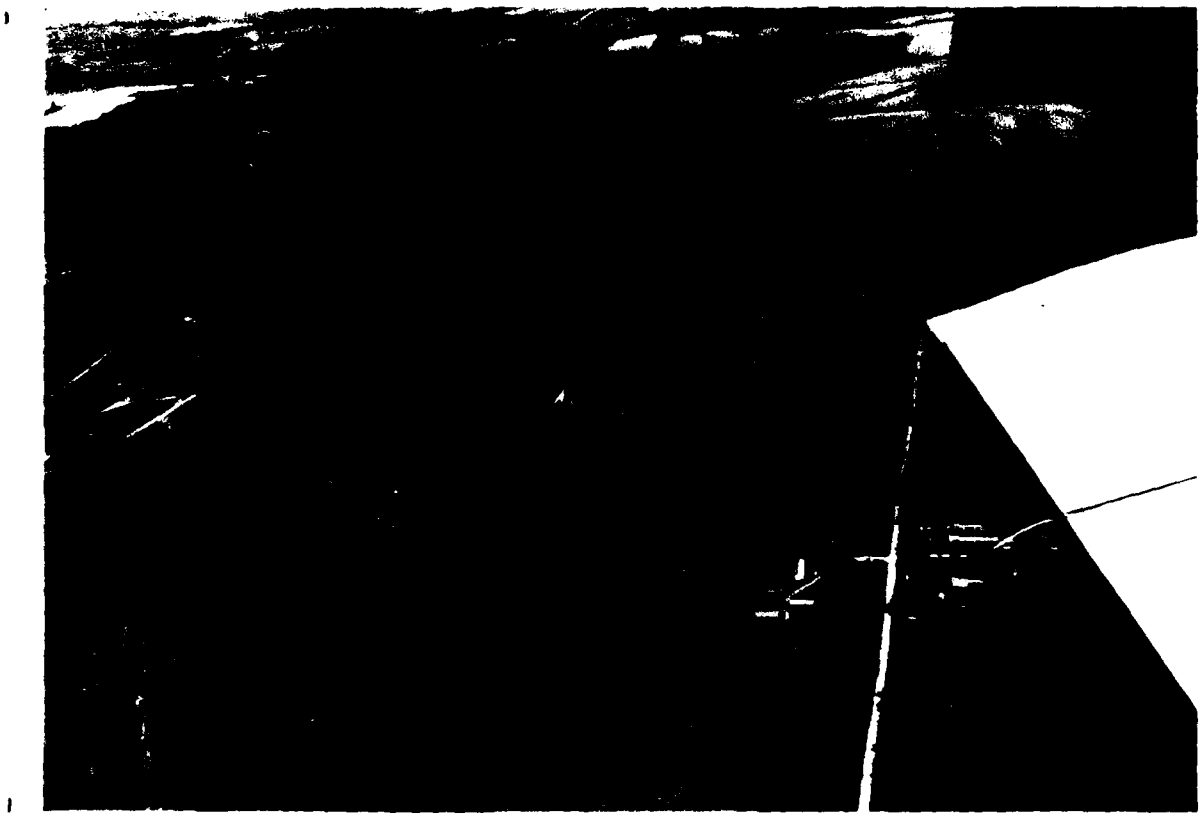


PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GRINDSTONE-LOST-MUDDY CREEK DAM C-3
DEKALB COUNTY, MISSOURI - MO 10384

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Grindstone-Lost-Muddy Creek Dam C-3 be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth fill of intermediate size located in gently rolling topography in the northwestern corner of Missouri about 10 miles northwest of Maysville. The dam is approximately 39 feet in height and has a maximum water storage at the minimum top of dam of 8,916 acre-feet. Upland soils in the area are developed in loess. Soils on the slopes are developed in loess colluvium and/or Kansan till.

The dam consists of two legs with the principal embankment oriented almost east-west and the secondary wing dike oriented northeast-southwest. The emergency spillway is located at the left end of the principal embankment.

(2) The principal spillway is uncontrolled and consists of a reinforced concrete drop inlet with antivortex device and trash rack connected with a reinforced concrete box conduit outletting into a chute with energy dissipating blocks.

(3) An uncontrolled vegetated earth emergency spillway is located between the principal east-west embankment and the secondary northeast-southwest wing dike on the left abutment.

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the northwest portion of Dekalb County in the NE 1/4 of Sec. 13, T60N, R32W, about 10 miles northwest of Maysville, Missouri. It is located on Lost Creek, a tributary of the Grindstone River.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Grindstone-Lost-Muddy Creek Dam C-3 has a height of 39 feet and a storage capacity of 8,916 acre-feet. This dam is classified as an intermediate size dam. An intermediate size dam has a height greater than or equal to 40 feet but less than 100 feet and a storage capacity greater than or equal to 1,000 acre-feet but less than 50,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines and visual observation, this dam is in the High Hazard Classification. The estimated damage zone extends for about 15 miles downstream of the dam. Within the damage zone are one dwelling with barns and State Highway A at 9.8 miles; a dwelling and barns at 12.5 miles; a dwelling and barns at 12.8 miles; a railroad at 13.8 miles and 2 trailer houses at 15 miles downstream.

e. Ownership. The dam is owned by the Soil and Water Conservation Districts of Daviess, Dekalb and Gentry Counties and by Mr. Brown Harris, Farmers Export Co., 1 Ward Parkway, Kansas City, Missouri 64112.

f. Purpose of Dam. The dam was constructed for flood control, recreation and future municipal water for the City of Maysville.

g. Design and Construction History. The dam was designed by the Soil Conservation Service, Columbia, Missouri and constructed in 1970 by Lexeco, Leavenworth, Kansas.

h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

1.3 PERTINENT DATA

a. Drainage Area. 12,160 acres (19.0 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through an uncontrolled reinforced concrete drop inlet (riser) with a reinforced concrete box conduit through the dam and an uncontrolled vegetated earth spillway.

(2) Estimated maximum flood - unknown. (It was reported by Mr. Carl Pierce, District Conservationist, that the spillway operated once shortly after dam was constructed at which time the reservoir got just up to the control section).

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 944.3 feet (orifice crest) to 230 c.f.s. at elevation 949.5 feet (weir crest) to 895 c.f.s. at elevation 955.2 feet (emergency spillway crest) to 1049 c.f.s. at elevation 962.4 feet (minimum top of dam).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 955.2 feet to 11,620 c.f.s. at elevation 962.4 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 12,669 c.f.s.±

c. Elevations. (Feet above M.S.L.)

(1) Top of dam - 962.4 (minimum measured) 961.7 (min. plans)

(2) Spillway crests

(a) Principal spillway crest (low stage) - 944.3

(b) Principal spillway crest (high stage) - 949.5

(c) Emergency spillway crest - 955.2 (measured) 954.7 (plans)

(3) Normal pool - 944.3

(4) Observed pool - 944.2

(5) Maximum experienced pool - 955 ±

(6) Streambed at centerline - 924 ±

(7) Maximum tailwater - Unknown

d. Reservoir. Length (feet of pool

(1) Principal Spillway - 8,900 ±

(2) Emergency Spillway - 15,800 ±

(3) Top of dam (Minimum) - 18,000 ±

e. Storage (Acre-feet).

(1) Top of dam (minimum) - 8916

(2) Spillway crests

(a) Principal spillway (low stage) - 1,293

(b) Principal spillway (high stage) - 2,693

(c) Emergency spillway - 4,773

(3) Normal pool - 1,293

(4) Observed pool - 1293 ±

(5) Maximum experienced pool - 4773 ±

f. Reservoir Surface (Acres).

(1) Top of dam (minimum) - 588 ±

(2) Spillway crests

(a) Principal spillway (low stage) - 231 ±

(b) Principal spillway (high stage) - 340 ±

(c) Emergency spillway - 448 ±

(3) Normal pool - 231 ±

(4) Observed pool - 231 ±

(5) Maximum experienced pool - 448 ±

g. Dam.

(1) Type - Homogeneous earth fill

(2) Length - 1920 ft. ± (plans)

(3) Height - 39 ft. ±

(4) Top width - 15 ft.

(5) Side slopes.

(a) Downstream 1V on 2.5 H

(b) Upstream 1V on 2.5 H with 10 feet berm

(6) Zoning - Homogeneous

(7) Impervious core - No

(8) Cutoff - 3 to 10 feet in depth, 12 foot bottom width, 1V on 1H side slopes.

(9) Grout curtain - None

(10) Wave protection - Riprap extending 5 feet below and 8 feet above permanent pool level.

(11) Foundation drain - trench and perforated pipe

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - Reinforced concrete riser 6 feet x 12 feet with a reinforced concrete conduit 6 ft. x 6 ft. connected with a reinforced concrete transition chute into a St. Anthony Falls (S.A.F.) type energy dissipater.

(b) Crest (invert) elevation - High stage - 949.5 ft.
Low stage (normal pool) 944.3 ft.
Outlet (conduit invert) elevation - 932 ft.

(c) Length - 128 ft.

(2) Emergency

(a) Type - vegetated earth, uncontrolled, located on left abutment between main embankment and N.E. wing dike. Bottom width - 200 feet; side slopes - 1V on 3H.

(b) Control section - 50 foot level section

(c) Crest elevation - 954.7 (plans), 955.3 (measured)

(d) Upstream Channel - vegetated and open

(e) Downstream Channel - vegetated, grade - 8%

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The structure was designed by the SCS, Columbia, Missouri. Copies of the Geologic and Soil Mechanics Reports are included in Appendix E. The plans are included in Appendix C.

2.2 CONSTRUCTION

The dam was constructed in 1970 by Lexeco, Leavenworth, Kansas. The S.C.S. provided technical supervision, inspection, and quality control for construction of the dam.

2.3 OPERATION

No data were available on spillway operation. It was reported by SCS personnel that water barely flowed over the crest of the emergency spillway within 6 months after the structure was completed.

2.4 EVALUATION

a. Availability. The data included in Appendix C and Appendix E were readily available from the SCS.

b. Adequacy. The data are considered adequate to support the conclusions of this report. Seepage and stability analyses presented in the SCS reports shown in Appendix E are considered adequate for this structure.

c. Validity. The data and analyses are considered valid and adequate.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Grindstone-Lost-Muddy Creek Dam C-3 was made on June 3, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R.S. Decker, Geotechnical; Garold Ulmer and Gordon Jamison, Hydrology.

b. Dam.

(1) Geology and Soils (abutment and embankment). This dam is located in the dissected till plains area. Upland soils consist of a thin mantle of loess (CL) underlain by glacial till (CL-CH). Abutments consist of a thin mantle of loess colluvium and/or glacial till. No till was observed at the site. The valley materials consist of 22 to 28 feet of CL alluvium underlain by silty sands (SM-ML) which are underlain by heavy till at depths of 30 to 36 feet. Materials in the dam consists of CL and CH alluvium and glacial till borrowed in the reservoir area below the permanent pool elevation.

(2) Upstream Slope. The upstream slope is well vegetated with adapted grasses from the crest down to the riprap. The riprap is durable limestone and looks good with no significant deterioration. A few small trees are growing along the waters edge in the left corner of the reservoir. Measurements indicate that the slope is somewhat flatter than shown on the plans. No slumps or deformations were observed on the slope. Photos 10, 11 and 12 show the upstream slope.

(3) Crest. The crest is well vegetated. No cracks, slumps or deformations were observed on the crest. Measurements indicate that crest elevations are essentially as constructed and in accordance with the plans. Photos 7 and 8 show the crest.

(4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. No cracks, slumps, or abnormal deformations were observed. No indications of seepage were observed on the slope or along the toe of the dam. The downstream slope is shown in Photos 4, 5, 6. The toe drain was not discharging at the time of inspection, but rust stains shown in Photo No. 17 indicate that the right drain has discharged in the past.

(5) Miscellaneous. The excellent vegetative cover and the nature of the materials in this dam would indicate that it could withstand significant overtopping without serious damage.

c. Appurtenant Structures.

(1) The Principal Spillway. The principal spillway consists of a reinforced concrete drop inlet (riser) with low level port; box conduit, and chute with energy dissipating blocks. The concrete in the inlet and outlet sections looks good with no signs of spalling or cracking. Inspection of the box conduit showed no cracks, spalling or abnormal elongation. The trash rack shows no sign of deterioration. Photos 14 and 15 show the inlet structure. Photos 16, 17 and 18 show the outlet structure. The second joint of the chute section (see E.J. 2 on sheet 4 of the plans) has opened up from the top downward on both sides of the chute wall. The opening on the right side is 1.3 inches at the top and tapers to zero down about 5 feet from the top. The opening on the left side is 1.3 inches at the top and about 0.4 inch down about 1 foot from the top. Photos 20 and 21 show the joint openings.

(2) The Emergency Spillway. The emergency spillway is very well vegetated with adapted grasses. There was no evidence of slumps, slides or erosion in the spillway. Discharge from the spillway will not encroach on the embankment. Measurements indicate the spillway was constructed according to the plans except that the crest elevation is slightly higher (0.3 to 0.5 ft.) than shown on the plans. Photos 22 and 23 show the spillway.

(3) Drawdown Facilities. Drawdown facilities consist of a 24-inch reinforced concrete pipe with rising stem slide gate. At the time of inspection, the gate valve was leaking at an estimated rate of 4-5 g.p.m. Photo No. 13 shows the slide gate.

d. Reservoir Area. The area around the reservoir is well vegetated with grass. No slumps or slides were evident around the reservoir. No significant erosion was observed along the shoreline. Photo 14 shows a portion of the reservoir.

e. Downstream Channel. The channel downstream from the principal spillway is open, clean and stable for a distance of 200-300 feet. Below this section the channel is pretty well clogged with trees and brush. Photo No. 16 shows the downstream channel.

3.2 EVALUATION

Measurements indicate that this structure was built essentially according to plans and specifications. It appears to be in excellent condition. A few deficiencies in maintenance (trees on upstream side, joint openings in the principal spillway outlet section) should be corrected.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works (except the small drawdown pipe) for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance of the structure appears to be good except for the minor deficiencies noted in Section 3 of this report. Periodic inspections of the dam are made by SCS and/or Soil and Water Conservation District personnel.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facility at this dam is the 24-inch drawdown pipe with slide gate control.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The overall appearance of this dam after 10 years of operation is excellent. The maintenance program for the dam should include removal of the small trees which are growing along the waters edge at the juncture of the principal embankment with the secondary wing dike and also repair of the joint openings in the concrete spillway outlet.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Pertinent hydraulic and hydrologic data used in evaluating the dam were taken from "as-built" plans furnished by the Soil Conservation Service, Maysville, Missouri and are shown in Appendix C, Plate C-20.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were taken from the SCS "as-built" plans and verified by the U.S.G.S. Darlington, Mo. and Stanberry, Mo. 15 minute topographic quadrangle maps. The hydraulic computations for the spillways and dam overtopping discharge ratings were based on the "as-built" plans and data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) The principal spillway appeared to be in good condition except as noted in Section 3.

(2) The emergency spillway appeared to be in excellent condition. Spillway releases will not endanger the integrity of the dam.

(3) There is a drawdown facility located in the principal spillway structure consisting of a 24-inch diameter reinforced concrete pipe with a 24-inch diameter slide gate. The slide gate was leaking approximately 3-5 gallons per minute at the time of inspection (see Photo No. 13).

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood or 50% of the probable maximum flood without overtopping. The spillways will pass the 1% probability flood as well as 35% of the probable maximum flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam ft.	Duration Over Top hr.
1/2 PMF	30,250	23,100	963.9	1.5	3+
PMF	60,500	58,700	966.1	3.7	7+
0.35 PMF	21,200	10,300	961.5	0	0

* Minimum top of dam elevation - 962.4

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. The dam appears to be structurally stable. There is no evidence of slips, slides, deformations nor seepage.

b. Design and Construction Data. Design data and "As Built" plans were available from the Soil Conservation Service and are included as Appendix C and Appendix E of this report. Seepage and stability analyses presented in the SCS report are considered adequate for this structure.

c. Operating Records. There are no controlled operating facilities for this dam except the drawdown facility to be used for emergencies.

d. Post Construction Changes. There have been no post construction changes for this structure.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The dam appears to be in excellent structural condition with no likely potential of failure. The flood from one-half the Probable Maximum Flood (PMF) will overtop the dam by 1.5 feet ± for about 3 hours. The PMF will overtop the dam about 3.7 feet for 7 hours ±. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The joint openings in the concrete spillway outlet should be repaired to minimize future problems. Willow trees growing in the upstream corner of the dam are not presently endangering the safety of the dam but should be removed before they spread into the entrance area of the emergency spillway.

b. Adequacy of Information. The design data and plans furnished by SCS and included as Appendix C and Appendix E of this report and the observations made during the inspection are considered adequate to support the conclusions and recommendations presented in this report. Seepage and stability analyses presented in the SCS report are considered adequate for this structure.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2.a should be pursued on a high priority basis.

d. Necessity for Further Investigations. Further investigations as required to implement the recommendations made in paragraph 7.2.a. should be conducted by the owner.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

a. Alternatives.

(1) The emergency spillway size and/or the height of the dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

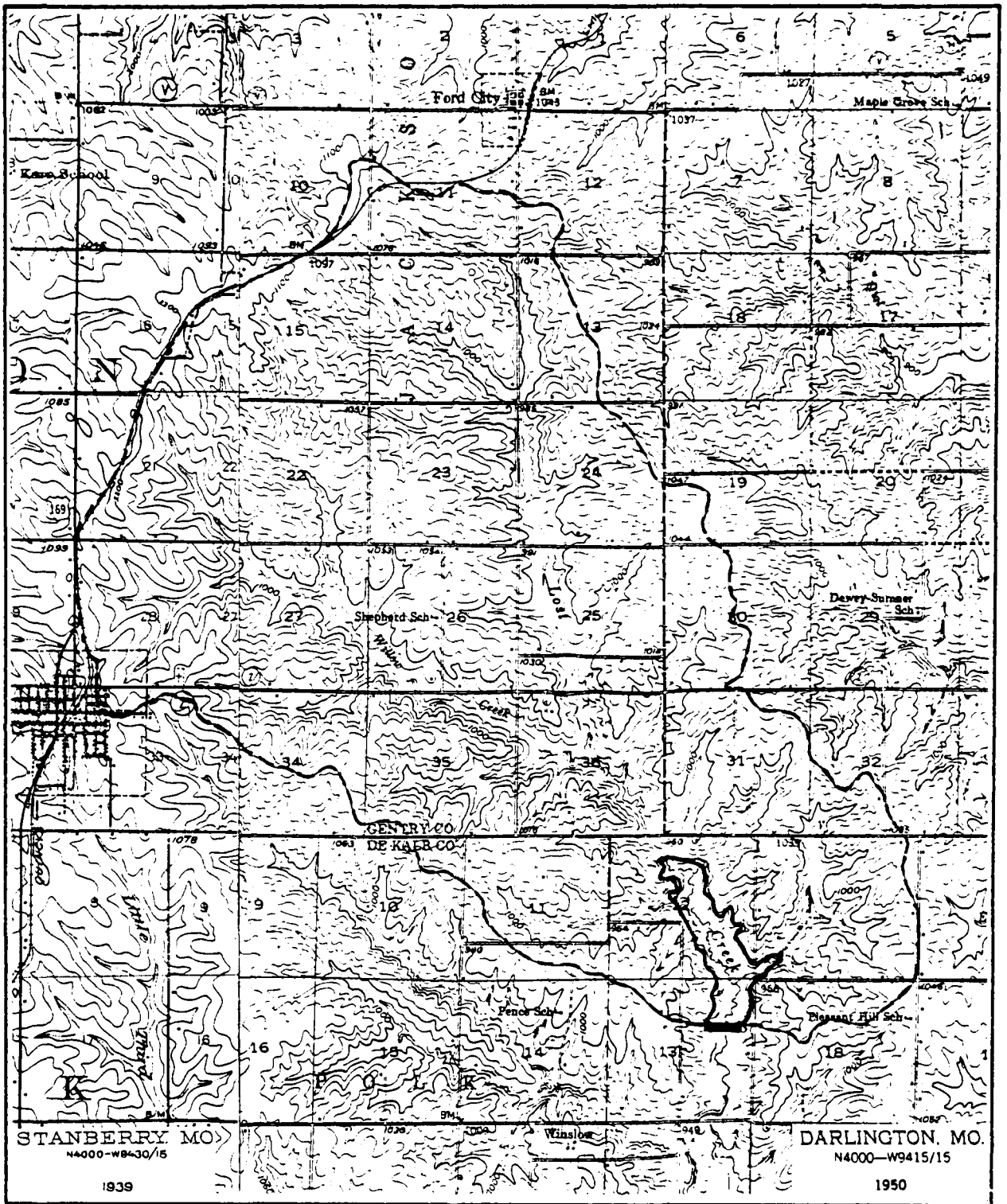
b. Operation and Maintenance Procedures.

(1) The joint openings in the concrete spillway outlet should be repaired.

(2) Tree growth on the upstream slope should be removed and measures taken to prevent recurrence. Large trees or trees with an extensive system of roots should be removed under the guidance of an engineer experienced in the design and construction of dams.

(3) Periodic inspection of the dam should be continued with inspection reports made a part of the records for this structure.

APPENDIX A
MAPS



Scale in feet

3000 0 3000 6000 9000 12000

Contour Interval – 20'

N

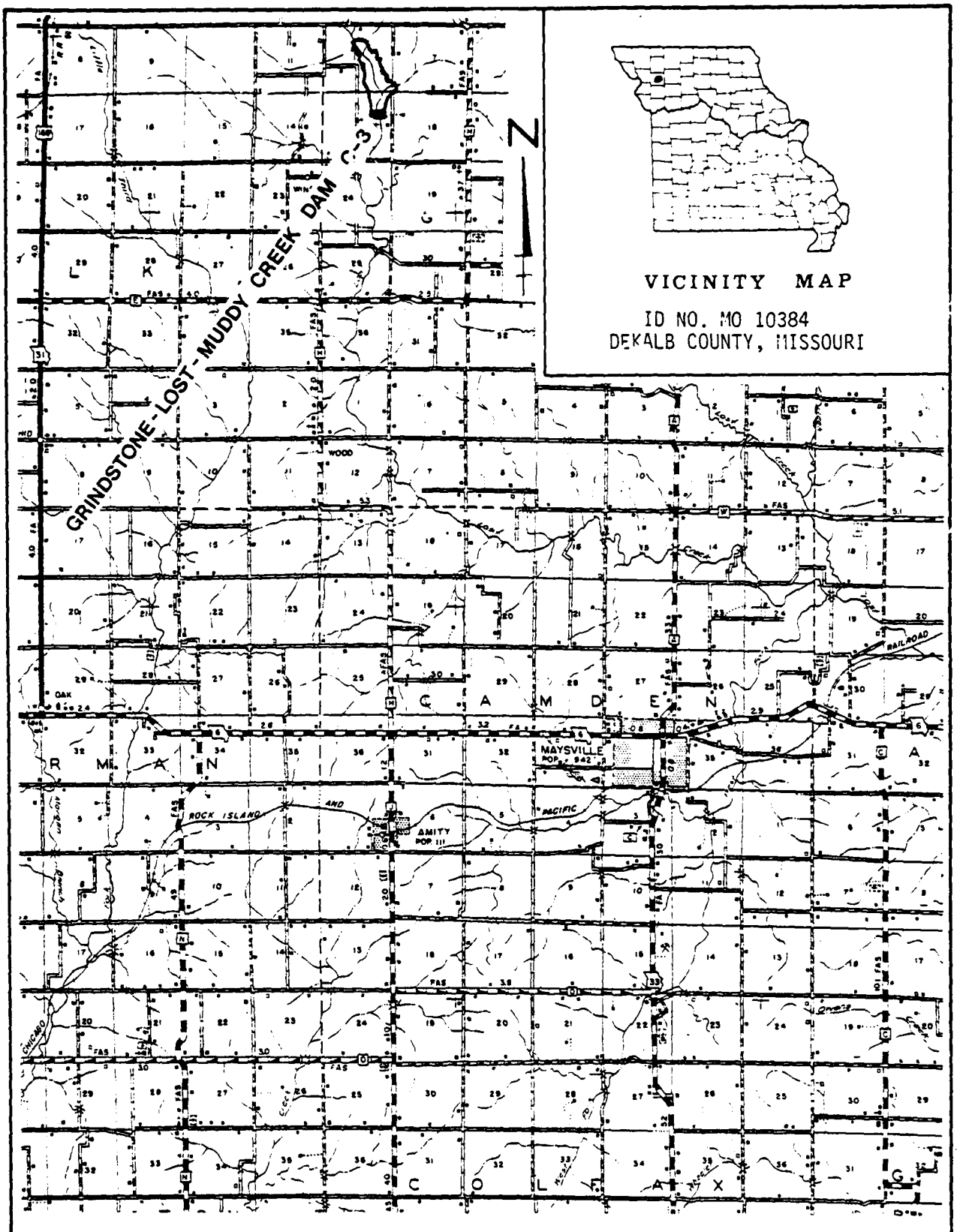
VICINITY TOPOGRAPHY

GRINDSTONE - LOST - MUDDY CREEK DAM C-3

DEKALB COUNTY, MISSOURI

MO. 10384

PLATE A-1


GRINDSTONE-LOST-MUDDY CREEK DAM C-3
N
VICINITY MAP
ID NO. MO 10384
DEKALB COUNTY, MISSOURI
CAMDEN
MAYSVILLE
POP. 942
AMITY
POP. 111
ROCK ISLAND
PACIFIC
RAILROAD
WOOD
OAK
RAIL ROAD
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

GRINDSTONE-LOST-MUDDY CREEK DAM C-3
DEKALB COUNTY, MISSOURI
MO 10384

PHOTO INDEX

PLATE B-1

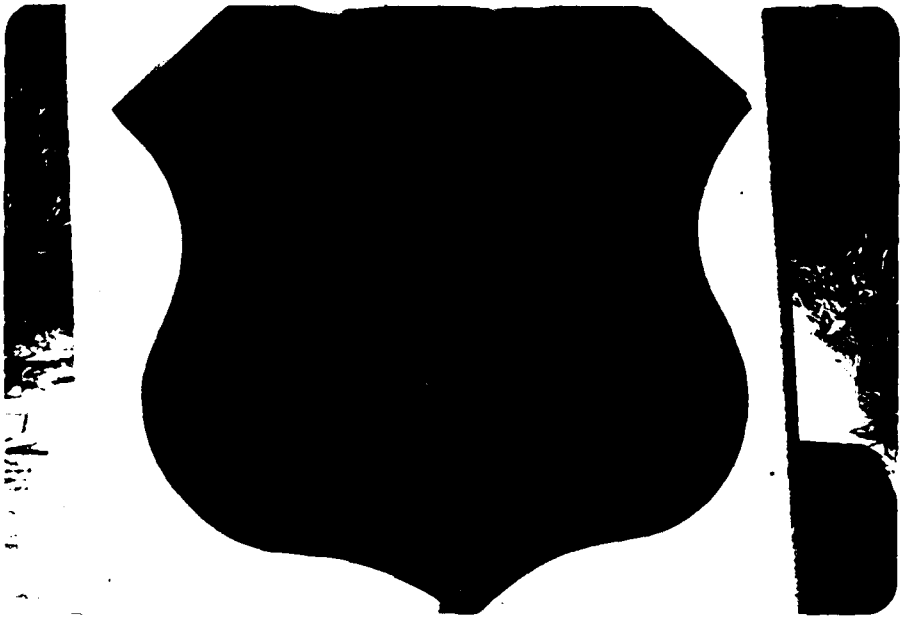


PHOTO NO. 2 - PROJECT PLAQUE

PHOTO NO. 3 - DOWNSTREAM SLOPE SHOWING EMERGENCY SPILLWAY ON EXTREME RIGHT TAKEN FROM COUNTY ROAD EAST OF DAM

PHOTO NO. 4 - DOWNSTREAM SLOPE FROM LEFT END

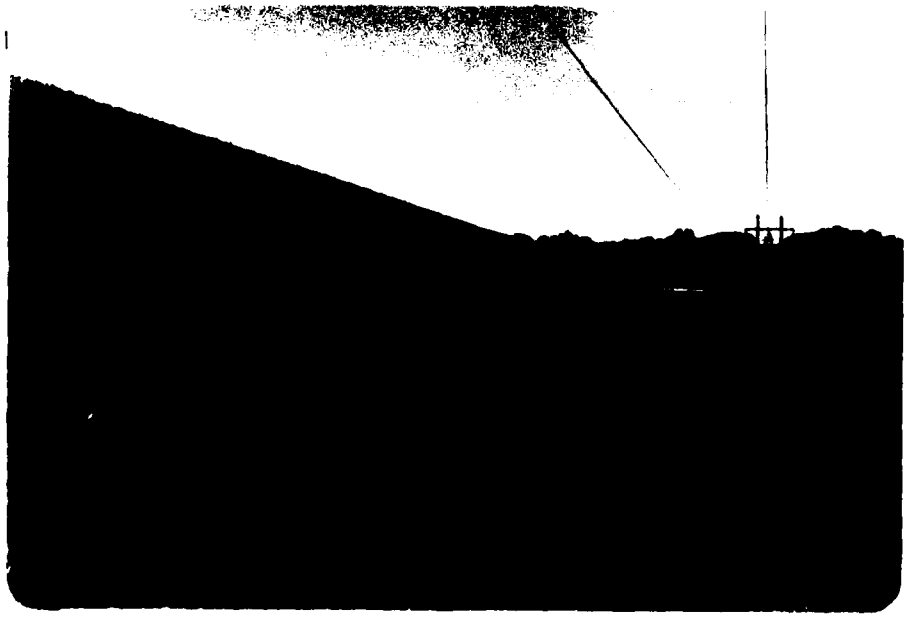


PHOTO NO. 5 - DOWNSTREAM SLOPE FROM RIGHT END

PHOTO NO. 6 - DOWNSTREAM SLOPE OF LEFT WING TAKEN FROM LEFT END

PHOTO NO. 7 - CREST OF LEFT WING FROM LEFT END

PHOTO NO. 8 - CREST OF RIGHT EMBANKMENT FROM LEFT END

PHOTO NO. 9 - OVERVIEW TAKEN FROM END OF LEFT WING

PHOTO NO. 10 - INLET OF EMERGENCY SPILLWAY

PHOTO NO. 11 - UPSTREAM FACE FROM LEFT END

PHOTO NO. 12 - UPSTREAM FACE SHOWING RIPRAP AND ENTRANCE CHANNEL OF EMERGENCY SPILLWAY IN BACKGROUND

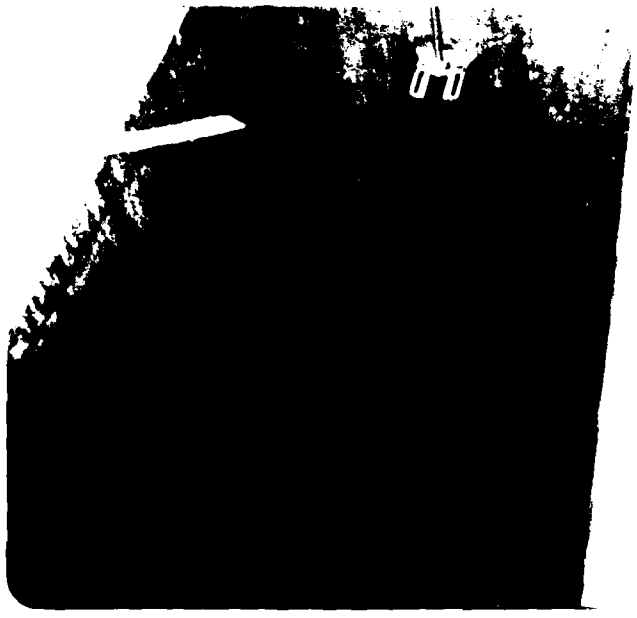


PHOTO NO. 13 - VALVE ON DRAWDOWN STRUCTURE

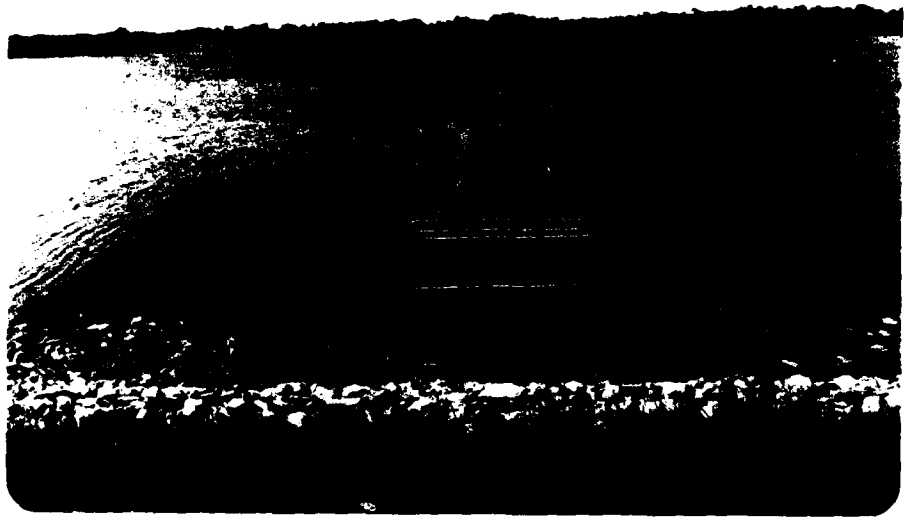


PHOTO NO. 14 - VIEW UPSTREAM, PRINCIPAL SPILLWAY INTAKE STRUCTURE IN FOREGROUND

PHOTO NO. 15 - INTAKE STRUCTURE FOR PRINCIPAL SPILLWAY

PHOTO NO. 16 - DOWNSTREAM CHANNEL AND OUTLET END OF PRINCIPAL SPILLWAY

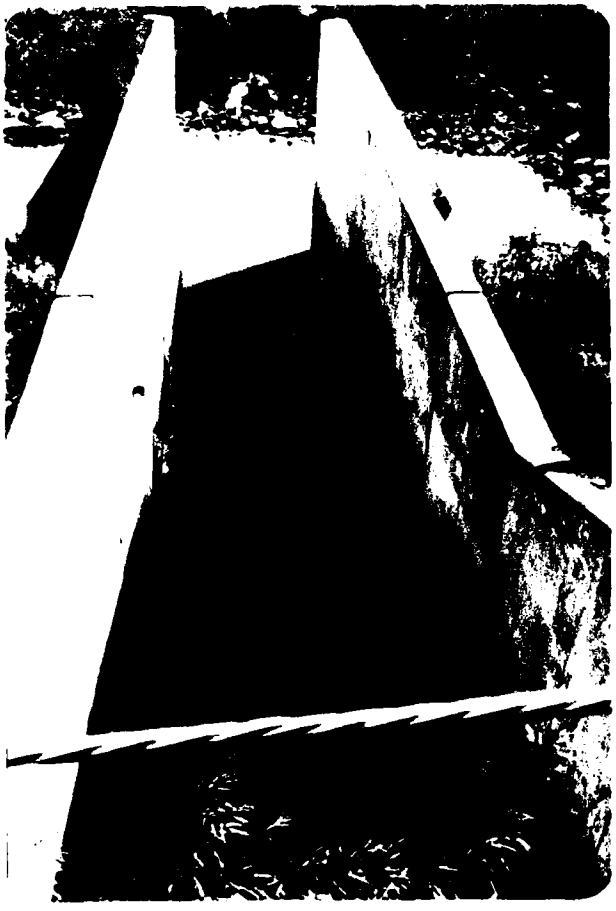


PHOTO NO. 17 - PRINCIPAL SPILLWAY OUTLET STRUCTURE. NOTE ENDS OF TOE DRAINS

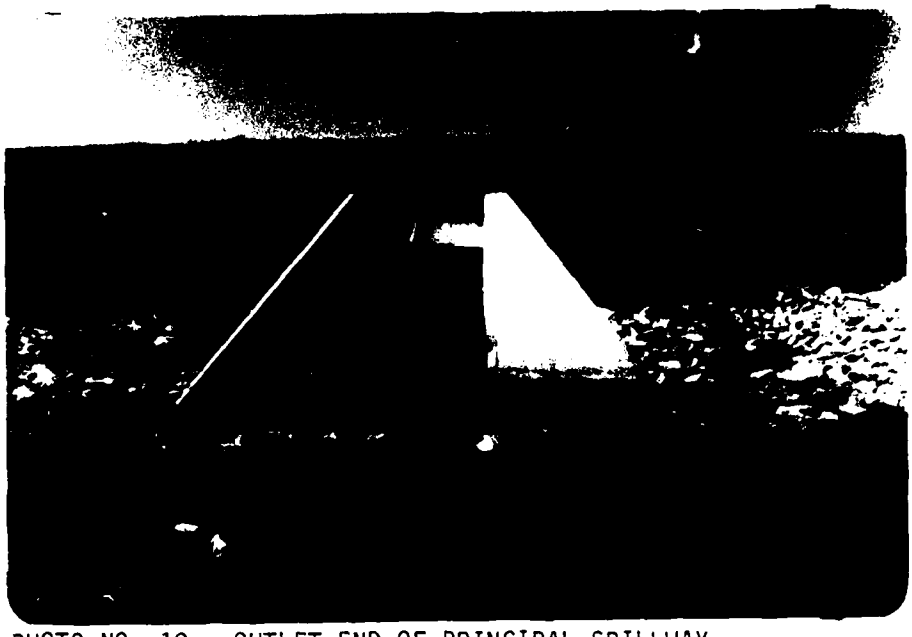


PHOTO NO. 18 - OUTLET END OF PRINCIPAL SPILLWAY

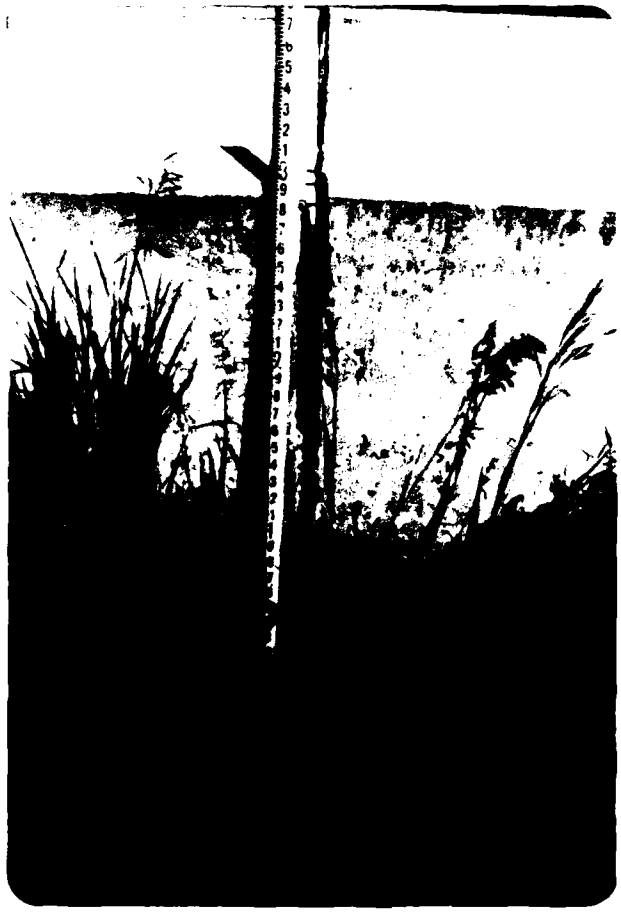


PHOTO NO. 19 - OPENING OF JOINT IN SPILLWAY STRUCTURE

PHOTO NO. 20 - OPENING OF JOINT IN RIGHT SIDE OF SPILLWAY STRUCTURE

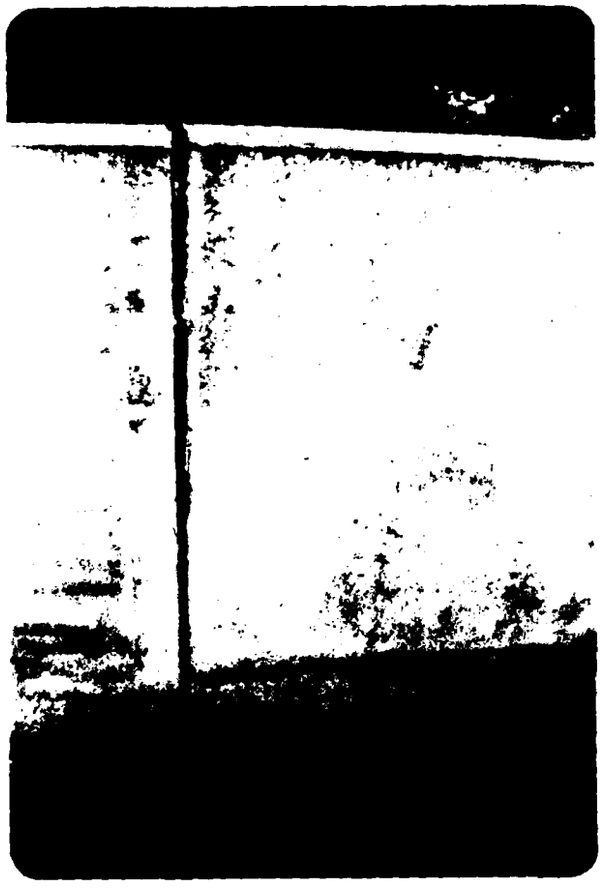


PHOTO NO. 21 - OPENING OF JOINT IN LEFT SIDE OF SPILLWAY STRUCTURE

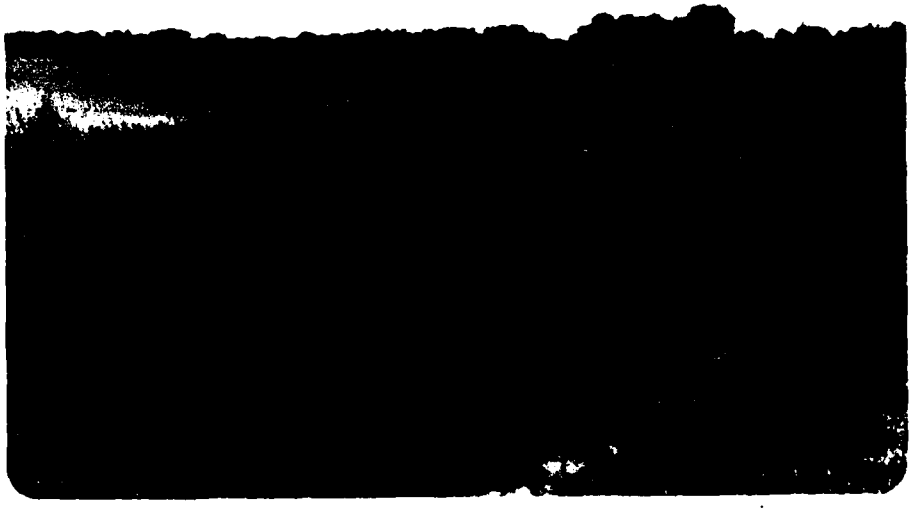


PHOTO NO. 22 - ENTRANCE SECTION OF EMERGENCY SPILLWAY FROM LEFT END OF DAM

PHOTO NO. 23 - VIEW DOWN OUTLET CHANNEL OF EMERGENCY SPILLWAY

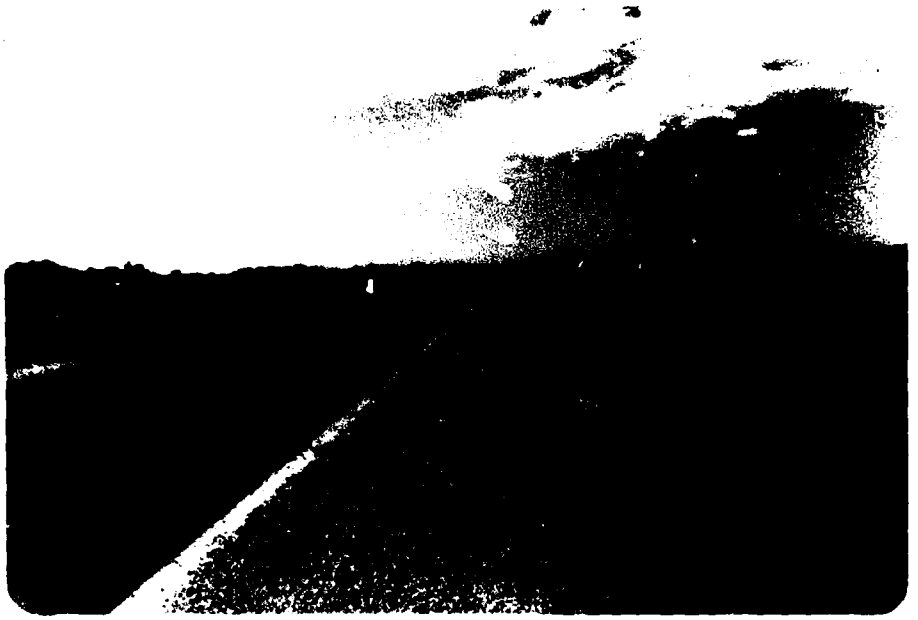
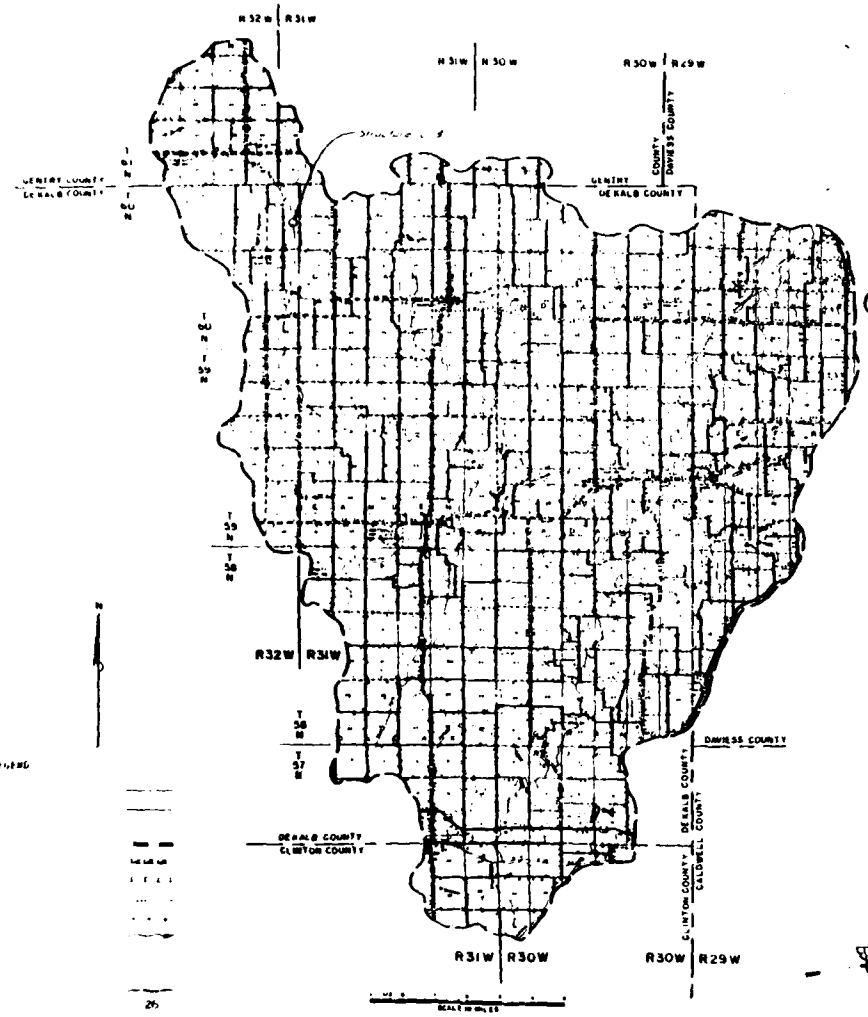


PHOTO NO. 24 - LOOKING NORTH FROM BRIDGE CROSSING ON HIGHWAY A SHOWING FLOOD PLAIN OF LOST CREEK

PHOTO NO. 25 - LOOKING SOUTH TOWARD LOST CREEK FLOOD PLAIN AT BRIDGE ON HIGHWAY A. ABOUT 8-9 MILES DOWNSTREAM

APPENDIX C
PROJECT PLATES



U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAIL PLANS FOR
GRINDSTONE - LOST - MUDDY CREEK WATERSHED PROTECTION AND FLOOD PREVENTION, MUNICIPAL WATER SUPPLY AND RECREATION PROJECT

CLINTON, DAVIESS, DEKALB AND GENTRY COUNTIES MISSOURI

IN COOPERATION WITH
SOIL AND WATER CONSERVATION DISTRICTS OF DAVIESS, DEKALB AND GENTRY COUNTIES; COUNTY COURTS OF DAVIESS, DEKALB AND GENTRY COUNTIES AND CITY OF MAYSVILLE, MISSOURI

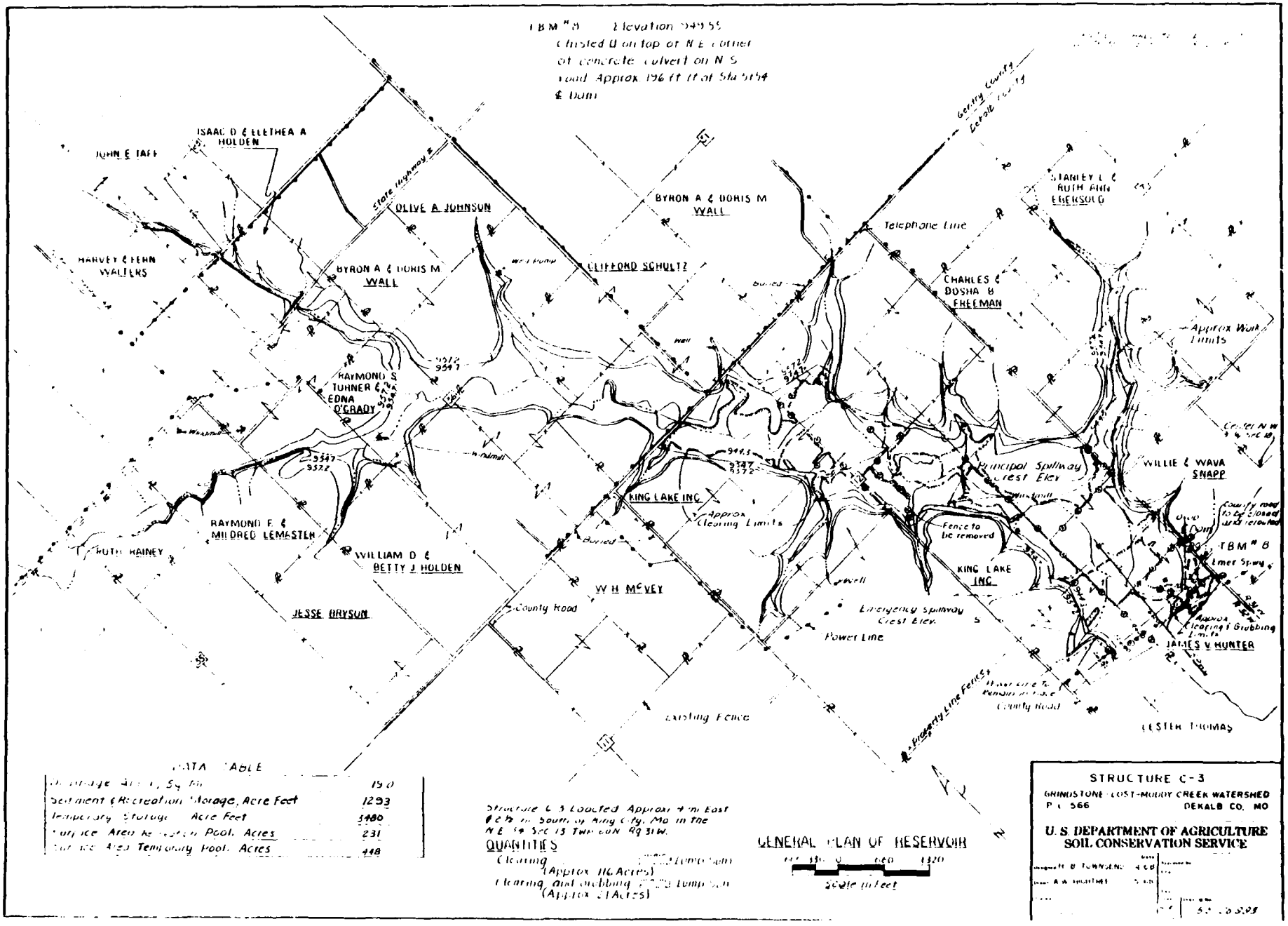
MULTI-PURPOSE STRUCTURE C 3

INDEX OF DRAWINGS

STATE CONSERVATION ENGINEER — DATE

[illegible] — 6-4-63

PLATE C-1



DATA TABLE

Drainage Area, Sq. Mi.	1.50
Sediment & Recreation Storage, Acre Feet	1293
Temporary Storage Acre Feet	3480
Surface Area Recreation Pool, Acres	231
Surface Area Temporary Pool, Acres	448

Structure C-3 Located Approx 4 mi East & 2¾ mi South of King City, Mo in the NE ¼ Sec 13 Twp 60N Rg 31W.

QUANTITIES

Clearing — Lump Sum (Approx 116 Acres)

Clearing and Grubbing — Lump Sum (Approx 21 Acres)

GENERAL PLAN OF RESERVOIR

0 660 1320

Scale in Feet

STRUCTURE C-3

GRINDSTONE-LOST-MOODY CREEK WATERSHED

P.L. 566 DEKALB CO., MO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

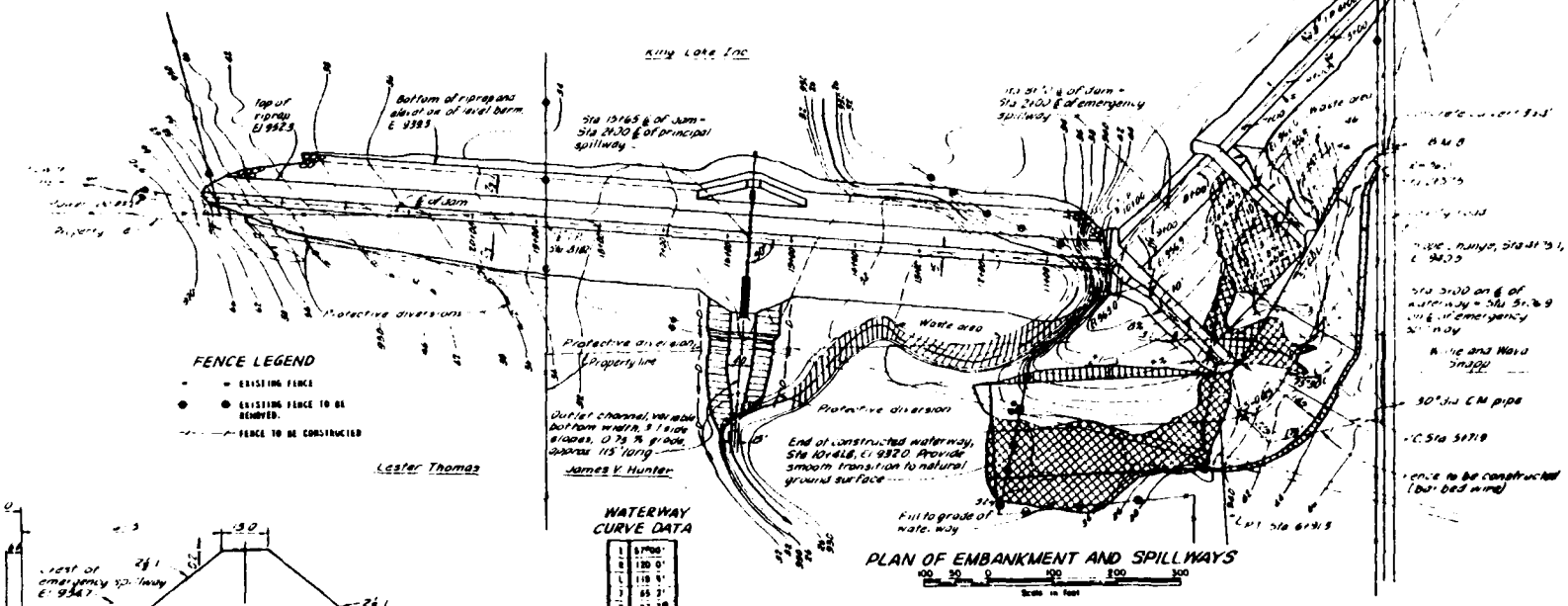
PLATE C-2

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
EXCAVATION, COMMON (1)		
CORE TRENCH	CU YDS	9,100
PRINCIPAL SPILLWAY TRENCH	CU YDS	985
OUTLET CHANNEL	CU YDS	2,760
STREAM CHANNEL	CU YDS	1,620
TOTAL	CU YDS	14,465
EARTH FILL, CLASS (A)	CU YDS	164,800
TOPSOIL	SQ YDS	13,550
BEDDING	CU YDS	875
RIPRAP	CU YDS	5,706
TOTAL - RIPRAP, EQUIPMENT PLACED	CU YDS	6,875
FARM FENCE, BARBED WIRE	LIN FT	900
WATERWAY (APPROXIMATELY 862 LIN FT.)	LUMP SUM	

NOTES

1. UNLESS AREAS SHALL BE AS SHOWN OR AS DESIGNATED BY THE ENGINEER
2. ALL COMPACTED EARTH FILL SURFACES, EMERGENCY SPILLWAY AND WATERWAY, SHALL BE COVERED WITH NOT LESS THAN 6" OF TOPSOIL
3. SELECTIVELY PLACE THE MOST PLASTIC MATERIAL TO THE CENTER OF THE DAM AND THE LESS PLASTIC MATERIAL TOWARD THE OUTSIDE AS DIRECTED BY THE ENGINEER
4. DO NOT BORROW CLOSER THAN 100' FROM TOE OF DAM
5. PROTECTIVE DIVERSION DIMENSIONS: 12' EFFECTIVE WIDTH, 3:1 SIDE SLOPES, MINIMUM BASE WIDTH 0'
6. CAUTION SHALL BE USED WHEN WORKING NEAR POWER LINES



FENCE LEGEND

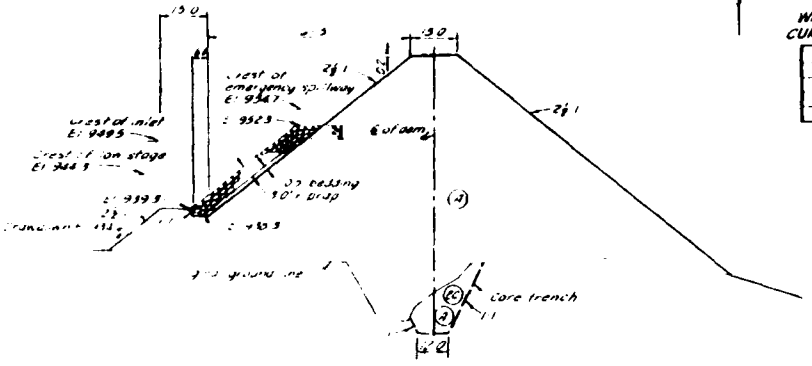
- = EXISTING FENCE
- = EXISTING FENCE TO BE REMOVED.
- = FENCE TO BE CONSTRUCTED

WATERWAY CURVE DATA

Δ	67°00'
R	120.0'
C	110.9'
T	65.2'
M	67.7'

PLAN OF EMBANKMENT AND SPILLWAYS

100 50 0 100 200 300
Scale in Feet



STA. 11+00

MAXIMUM SECTION OF EMBANKMENT

EMBANKMENT MATERIAL SOURCES AND PLACEMENT REQUIREMENTS

EMBANKMENT ZONE	SOURCE OF MATERIAL: LOCATION	APPROX DEPTH (FT.) FROM	TO	UNIFIED SOIL CLASSIFIC	PLACEMENT AND MOISTURE DENSITY REQUIREMENT: DEPTH OF LIFT	MAX SIZE ROCK FRAGMENTS	FILL MATRIX SIZE TESTED	COMPACTION CLASS	REFERENCE TEST METHOD	REQ'D (%) COMPACTION	ALLOWABLE MOISTURE RANGE FROM OPTIMUM (%)
ALL	BORROW AREA	0	9.5	CL	9"	6"	- #4	A	ASTM D-698 METHOD A	95	2% BELOW OR ABOVE
CENTER SECTION	BORROW AREA	0	10	CH	9"	6"	- #4	A	ASTM D-698 METHOD A	95	2% BELOW OR ABOVE
ALL	EMERGENCY SPILLWAY	0	3	----	9"	6"	-	A		95	2% BELOW OR ABOVE

LABORATORY TEST INFORMATION ON TYPICAL MATERIALS

UNIFIED SOIL CLASSIFICATION	CL	CL	CH	CH
REFERENCE TEST METHOD	ASTM D-698 METHOD A	ASTM D-698 METHOD A	ASTM D-698 METHOD A	ASTM D-698 METHOD A
MAXIMUM DRY DENSITY	96.5	108.5	97.5	105.5
OPTIMUM MOISTURE	21.5	17.0	22.5	17.0

STRUCTURE C-3

PLAN OF EMBANKMENT AND SPILLWAYS

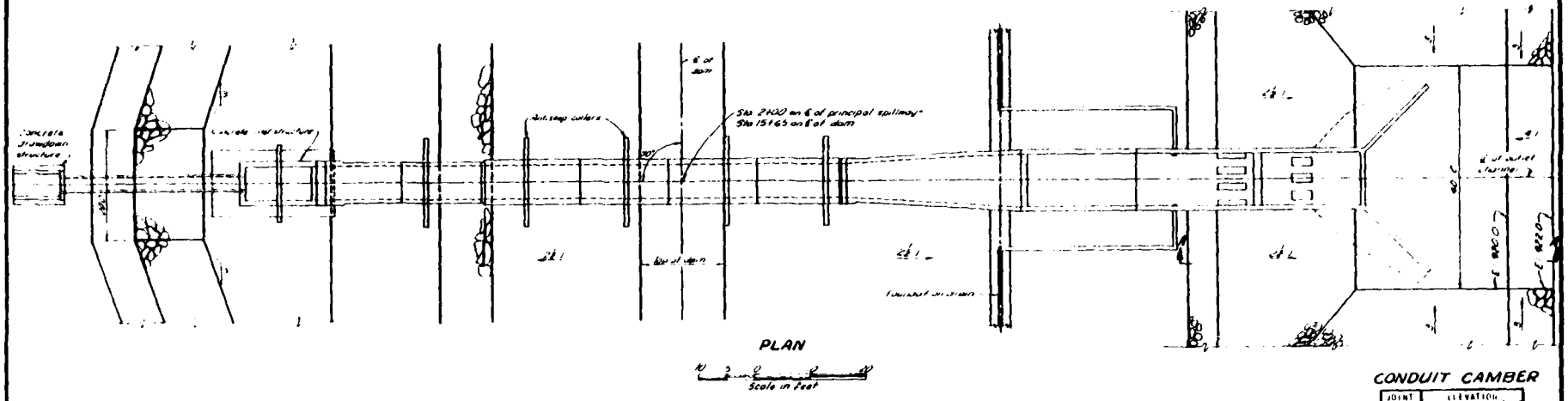
GRINDSTONE - LOST MUDDY CREEK

WATERSHED PL 566, DEKALB CO., MO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

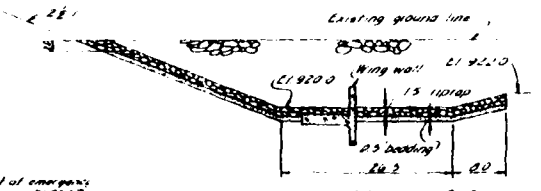
S.E. 26,999

PLATE C-3



PLAN

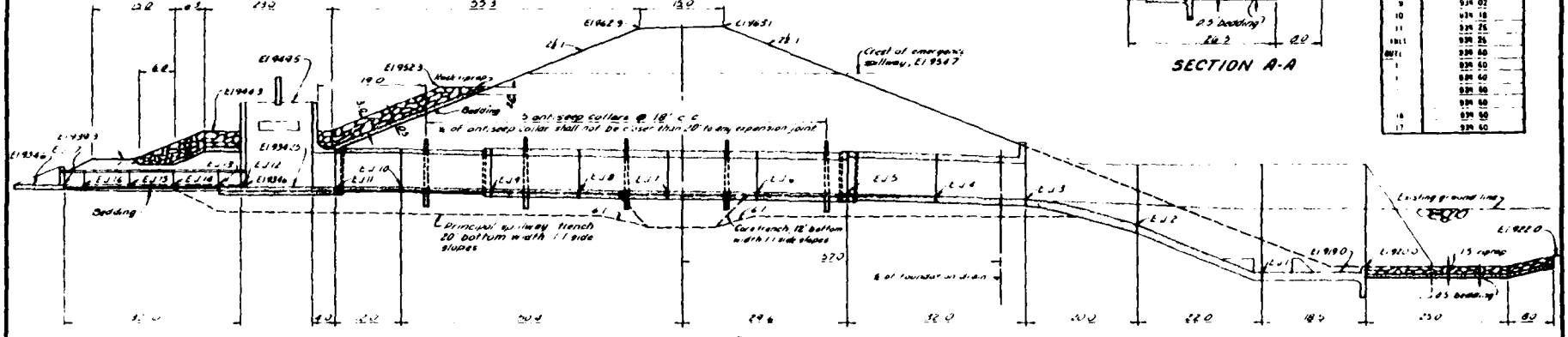
Scale in Feet



SECTION A-A

CONDUIT CAMBER

JOINT	ELEVATION
1	919.00
2	927.91
3	932.14
4	932.71
5	933.18
6	933.50
7	933.70
8	933.84
9	934.02
10	934.18
11	934.26
INLET	934.26
OUTLET	934.88
1	934.60
	934.60
	934.60
	934.60
	934.60
16	934.60
17	934.60



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

Scale in Feet

QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE - PLAIN - CLASS 2500	CU YDS	1.0
CONCRETE - REINFORCED - CLASS 3000	CU YDS	339.0
STEEL BAR REINFORCEMENT	LBS	50,284
PIPE CONDUIT - REINFORCED CONCRETE (PRESSURE) 24" DIA	LIN FT	22
ALUMINUM TRASH RACKS (FOR R/C INLET AND DRAWDOWN STRUCTURE)	EACH	2
SLIDE GATE	EACH	1

STRUCTURE C-3

DETAILS OF PRINCIPAL SPILLWAY LAYOUT

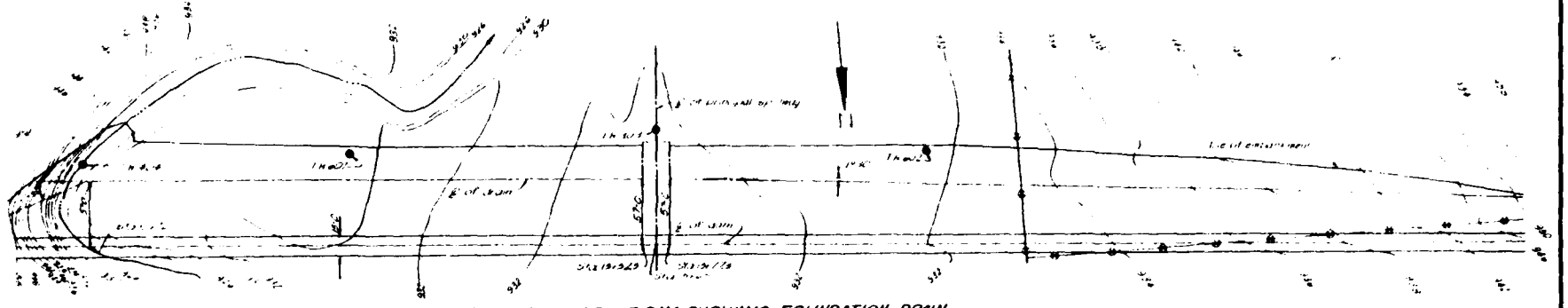
GRINDSTONE-LOST MUDDY CREEK

WATERSHED PL 566, DEKALB CO., MO

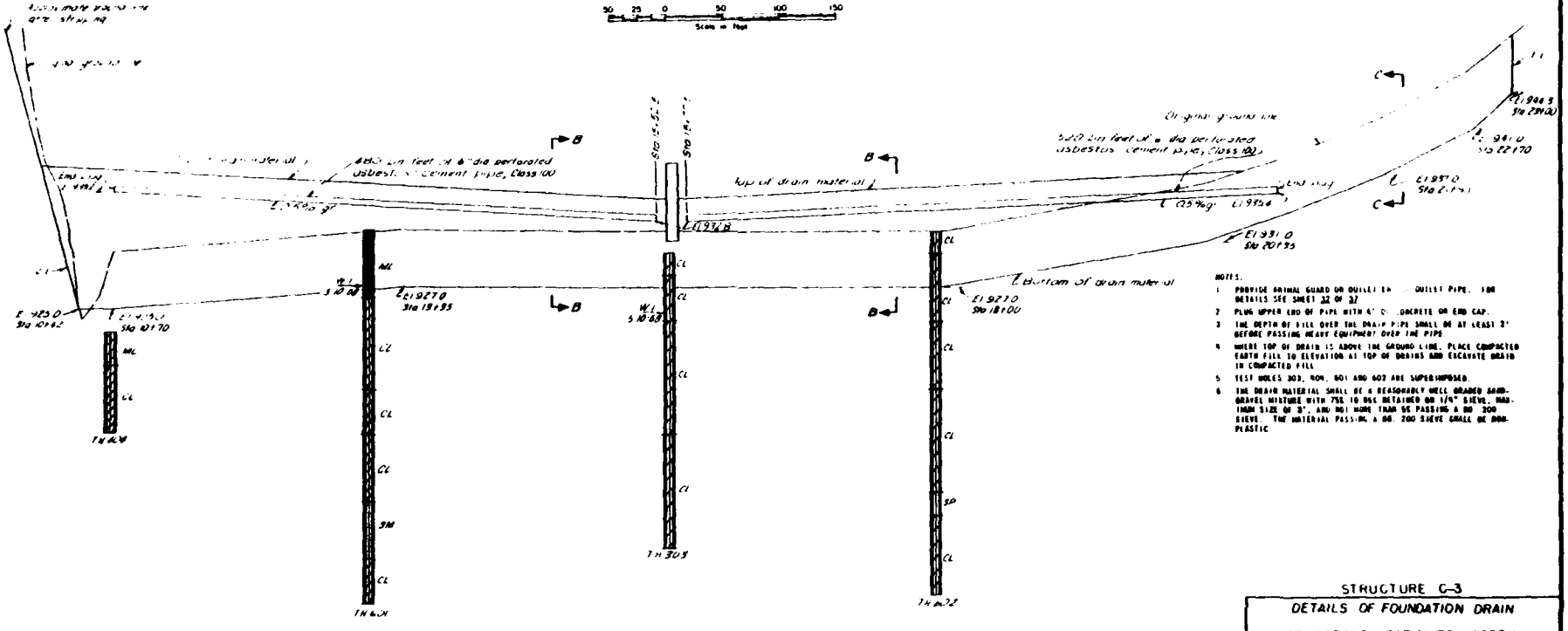
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

S.E-26,993

PLATE C-4



PLAN OF BASE OF DAM SHOWING FOUNDATION DRAIN



PROFILE ALONG ℄ OF FOUNDATION DRAIN

NOTES.

1. PROVIDE ANIMAL GUARD OR OUTLET EN... OUTLET PIPE. FOR DETAILS SEE SHEET 32 OF 37
2. PLUG UPPER END OF PIPE WITH 6" C... CRETE OR END CAP.
3. THE DEPTH OF FILL OVER THE DRAIN PIPE SHALL BE AT LEAST 2' BEFORE PASSING HEAVY EQUIPMENT OVER THE PIPE
4. WHERE TOP OF DRAIN IS ABOVE THE GROUND LINE, PLACE COMPACTED EARTH FILL TO ELEVATION AT TOP OF DRAINS AND EXCAVATE DRAIN IN COMPACTED FILL
5. TEST HOLES 303, 604, 601 AND 602 ARE SUPERIMPOSED.
6. THE DRAIN MATERIAL SHALL BE A REASONABLY WELL GRADED SAND-GRAVEL MIXTURE WITH 75% TO 95% RETAINED ON 1/4" SIEVE, MAXIMUM SIZE OF 3", AND NOT MORE THAN 5% PASSING A NO. 200 SIEVE. THE MATERIAL PASSING A NO. 200 SIEVE SHALL BE NON-PLASTIC

STRUCTURE C-3

DETAILS OF FOUNDATION DRAIN

GRINDSTONE-LOST-MUDDY CREEK

WATERSHED PL 566, DEKALB CO., MO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed F.D.

Drawn

Traced

Checked

Date

Approved by

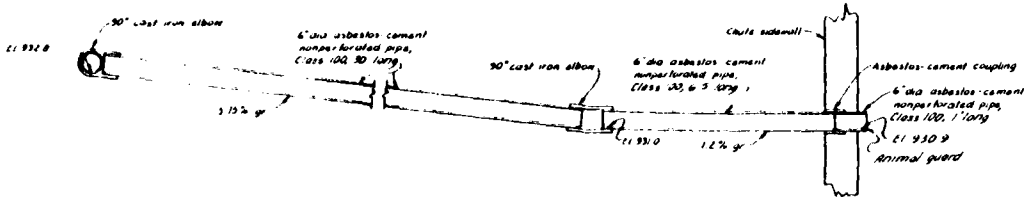
Title

Date

Sheet 3 of 38

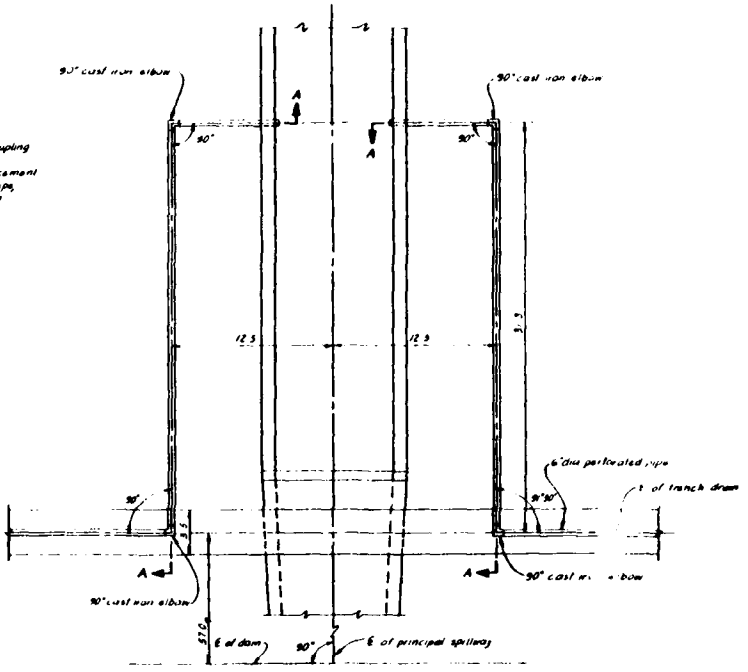
Drawing No. 5-E-26,993

PLATE C-5

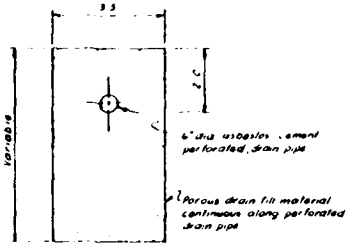


SECTION A-A

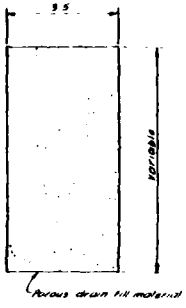
PROFILE ALONG ℄ OF OUTLET PIPES



PLAN OF OUTLET PIPES



SECTION B-B



SECTION C-C

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
EXCAVATION	CU YDS	1,870
DRAIN FILL MATERIAL	CU YDS	1,370
6" DIA. ASBESTOS-CEMENT PERFORATED PIPE, CLASS 100	LIN FT	1,000
6" DIA. ASBESTOS-CEMENT NONPERFORATED PIPE, CLASS 100	LIN FT	75
90° CAST IRON ELBOWS	EACH	9
ANIMAL GUARD	EACH	2

STRUCTURE C-3

DETAILS OF FOUNDATION DRAIN

GRINDSTONE-LOST-MUDDY CREEK

WATERSHED PL 566, DEKALB, CO., MO.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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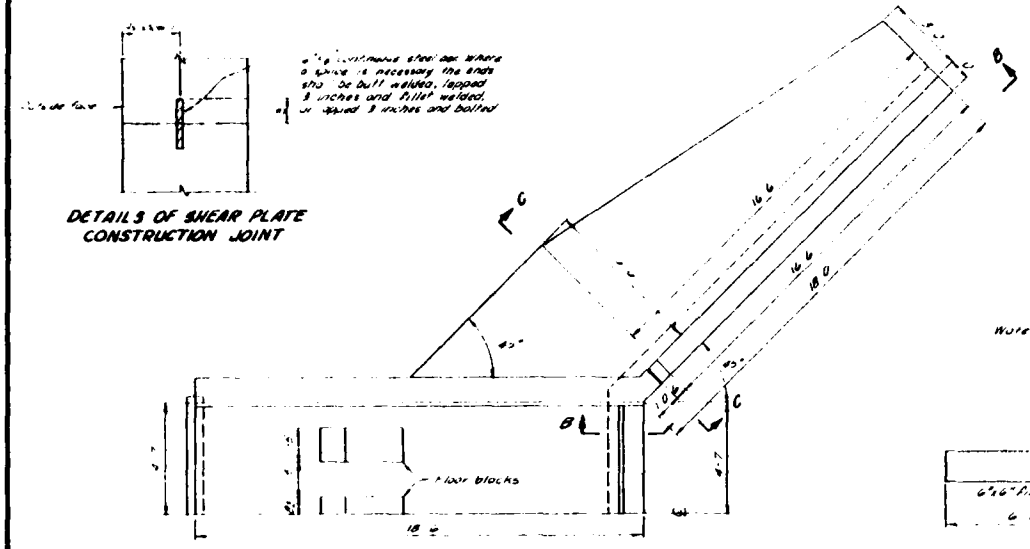
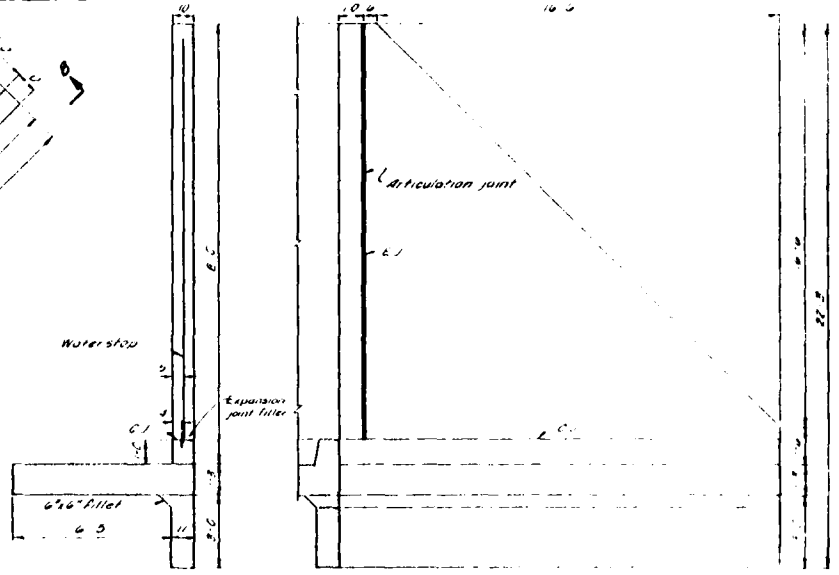
Date
Approved by
Title
Scale
Drawing No.
No. of Sh.
5-E-26,993

PLATE C-6

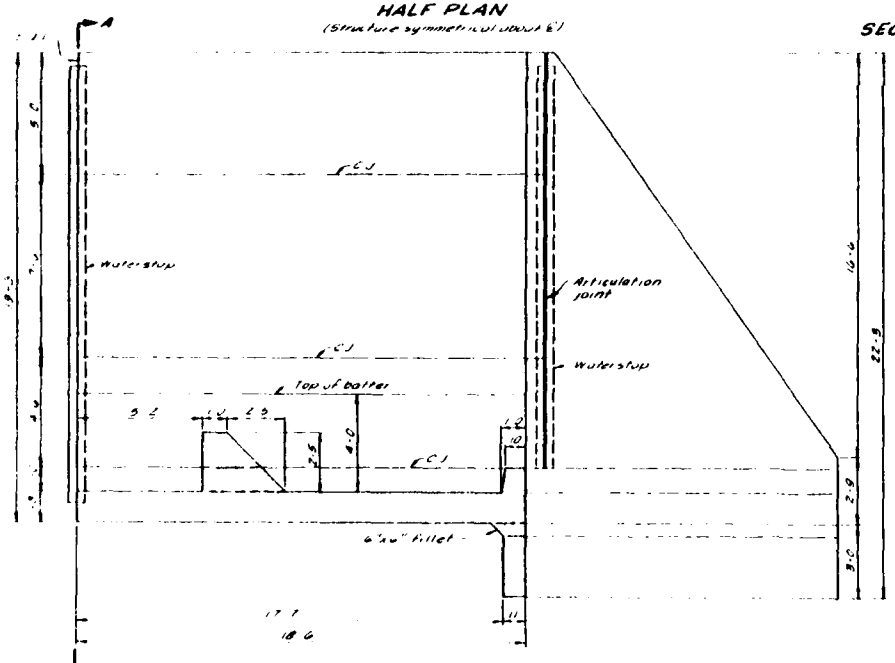


DETAILS OF SHEAR PLATE CONSTRUCTION JOINT

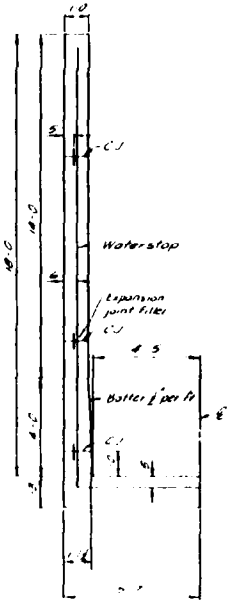


SECTION C-C

SECTION B-B



SECTION ON CENTERLINE



SECTION A-A

MATERIAL NOTES:
1. FOR DETAILS OF DOWEL BARS SEE SHT #2
2. SHEAR PLATE CONST. JOINT = C.J.
3. CHAMFER ALL EXPOSED EDGES 3/4"

TABLE OF QUANTITIES

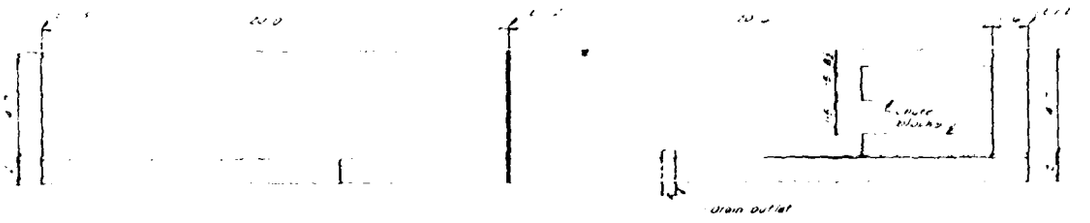
ITEM	UNIT	QUANTITY
CONCRETE (CLASS [illegible])	CU. YDS.	68.25
REINFORCING STEEL	LBS.	9100

STRUCTURE C-3

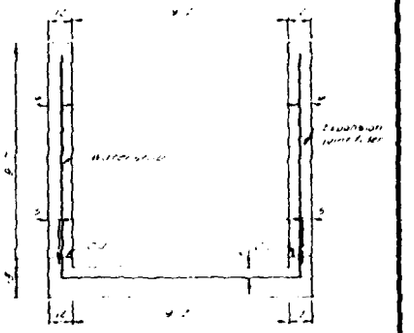
DETAILS OF R/C OUTLET
GRINDSTONE-LOST MUDDY CREEK
WATERSHED PL 566, DEKALB CO., MO
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

S.E 26, 893

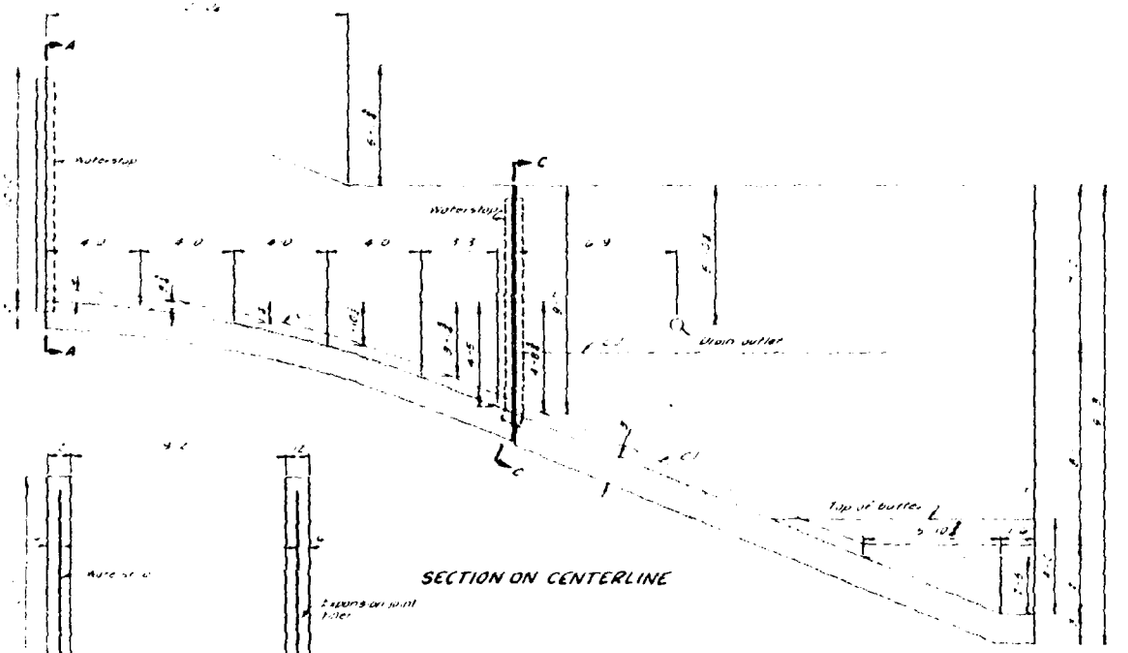
PLATE C-7



HALF PLAN

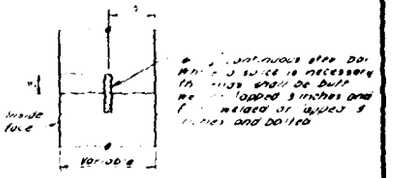


SECTION C-C



SECTION ON CENTERLINE

SECTION A-A



DETAILS OF SHEAR PLATE CONSTRUCTION JOINT

NOTES

1 E.J. = EXPANSION JOINT
2 C.J. = (CONSTRUCTION) OR JOINT
3 CHAMFER ALL EXPOSED EDGES 3/4
4 FOR DETAILS OF DOWEL BAR SEE SHEET 12

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS "BOO")	CU YDS	58.70
REINFORCING STEEL	LBS	6795

STRUCTURE C-3

DETAILS OF R/C CHUTE

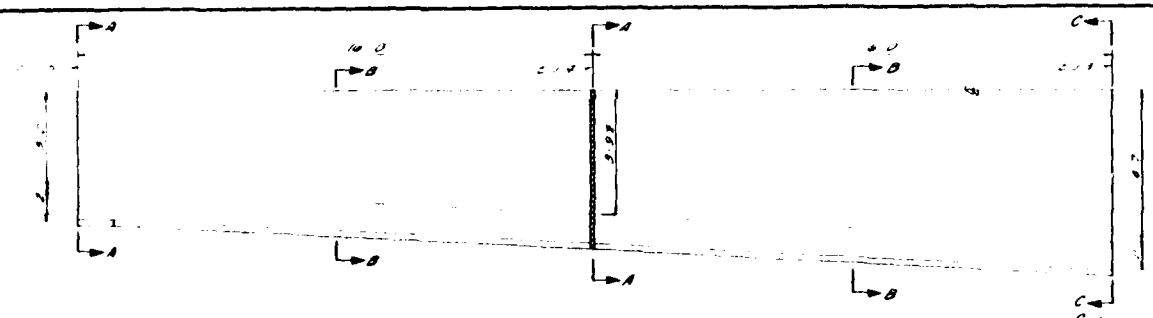
GRINDSTONE-LOST MUDDY CREEK

WATERSHED PL 566, DEKALB CO., MO

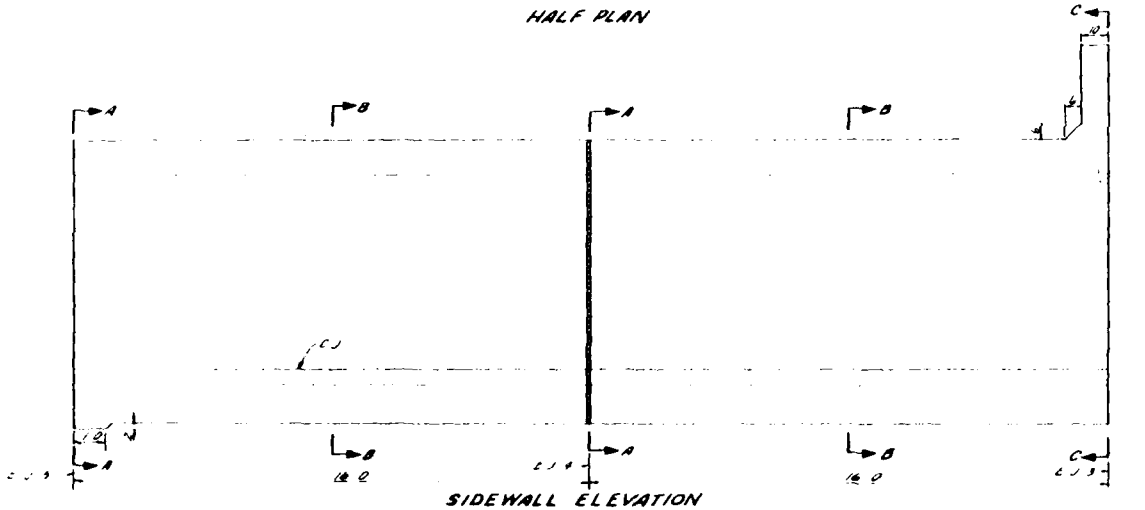
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

S.E 26,993

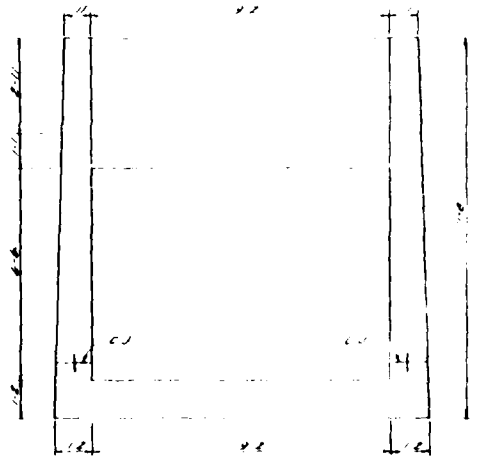
PLATE C-8



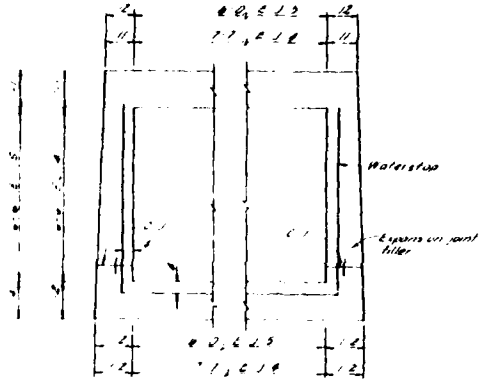
HALF PLAN



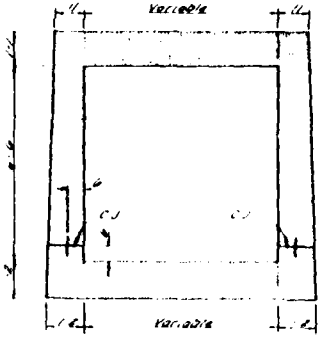
SIDEWALL ELEVATION



SECTION C-C



SECTION A-A
DETAIL OF EXPANSION JOINTS 4 AND 5



SECTION A-A
AND
SECTION B-B

NOTES

1. E J = EXPANSION JOINT
2. C J = CONSTRUCTION JOINT
3. CHAMFER ALL EXPOSED EDGES 3/4
4. FOR DETAILS OF DOWEL BAR SEE SHEET 32
5. FOR DETAILS OF SHEAR PLATE CONSTRUCTION JOINT SEE SHEET 18 OR 36

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS 4000)	CU YDS	92.95
REINFORCING STEEL	LBS	8498

STRUCTURE C-3

DETAILS OF R/C TRANSITION SECTION

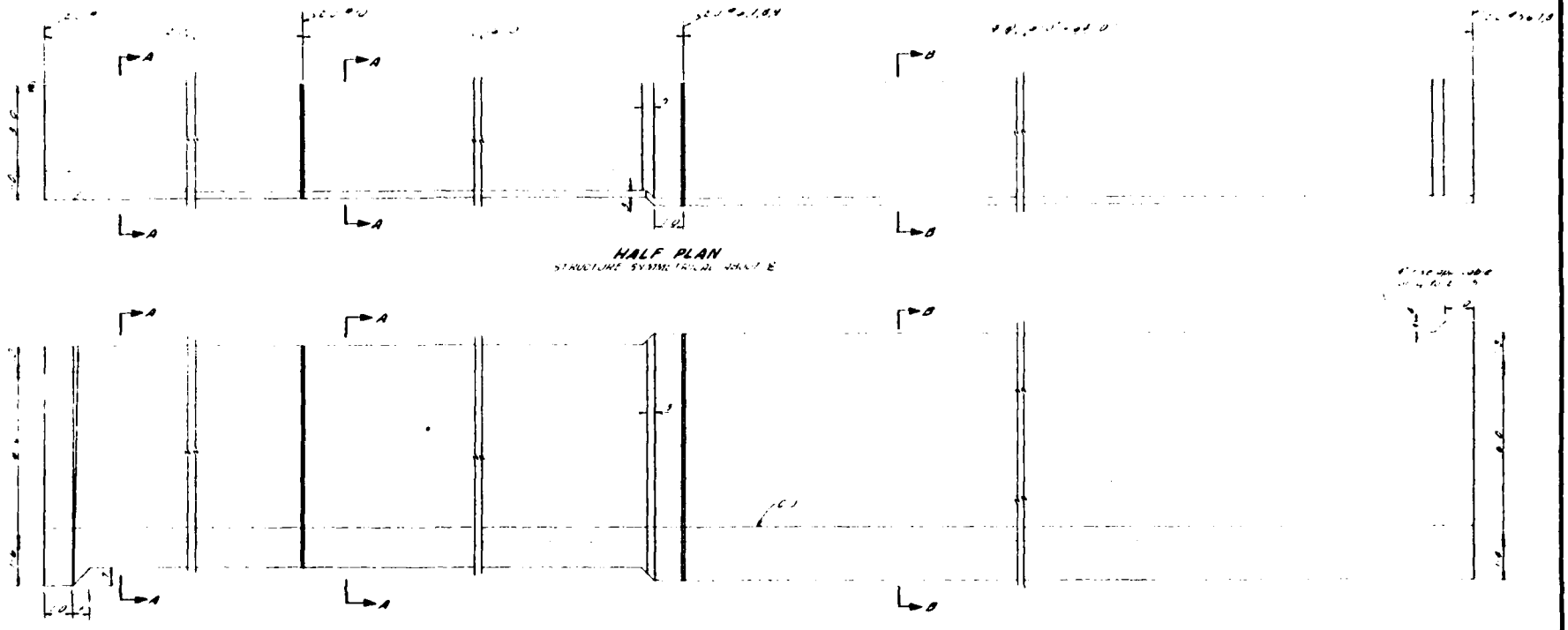
GRINDSTONE LOST MUDDY CREEK

WATERSHED PL 566, DEKALB CO, MO

U.S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

5-E-26,093

PLATE C-9



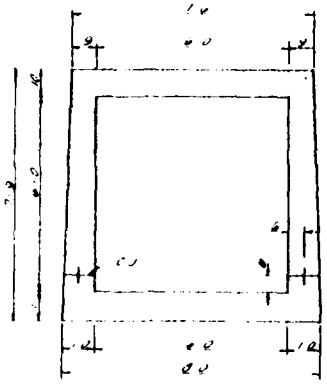
HALF PLAN

SIDEWALL ELEVATION

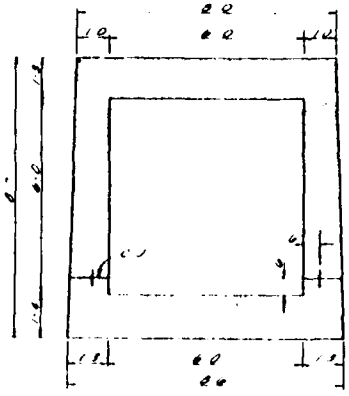
TABLE OF QUANTITIES

ITEM		UNIT	QUANTITY
CONDUIT:	CONCRETE	CU YDS	100.00
	REINFORCING STEEL	LBS	16 962
ANTISEEP COLLARS	CONCRETE	CU YDS	17.13
	REINFORCING STEEL	LBS	867

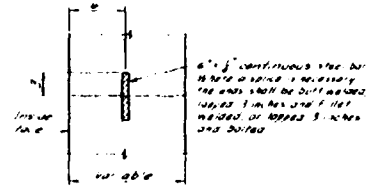
NOTES: 1 E.J. - EXPANSION JOINT
2 C.J. - CONSTRUCTION JOINT
3 FOR DETAILS OF DOWEL BAR SEE SHEET 02



SECTION A-A



SECTION B-B



DETAILS OF SHEAR PLATE CONSTRUCTION JOINT

Scale in feet

STRUCTURE C 3

DETAILS OF CONDUIT

GRINDSTONE LOST MUDDY CREEK

WATERSHED PL 566, DEKALB CO., MO.

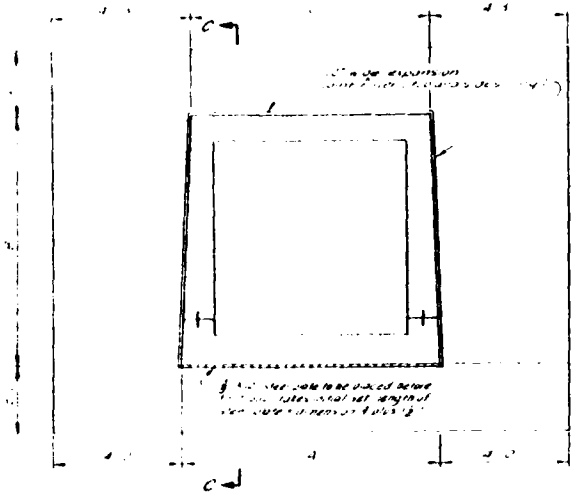
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed - A.T.
Drawn - D.J.R.
Traced
Checked - W.H.

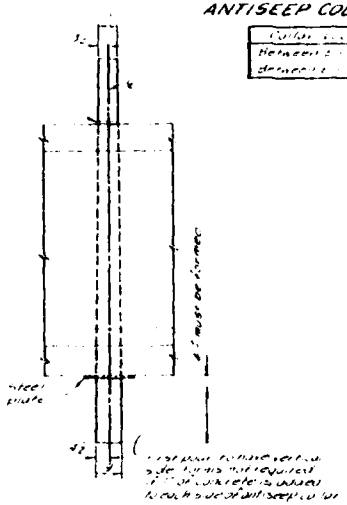
Approved by
Title
Date
Drawing No.
S.E.-26,993

PLATE C-10

ANTISEEP COLLAR DIMENSIONS

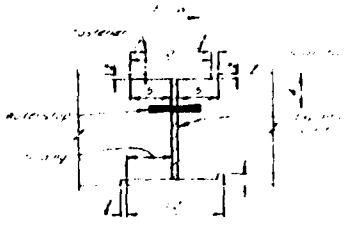


TRANSVERSE SECTION

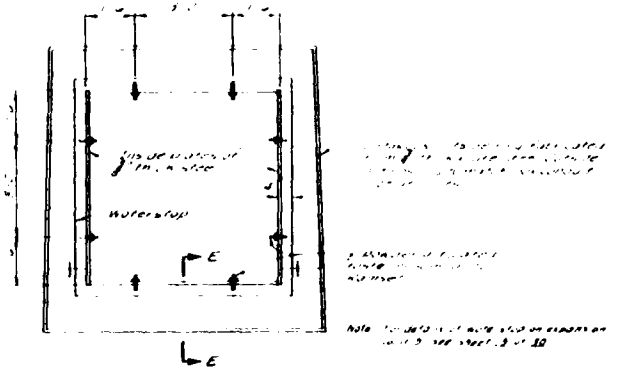


SECTION C-C

STRUCTURAL DETAILS OF ANTISEEP COLLARS

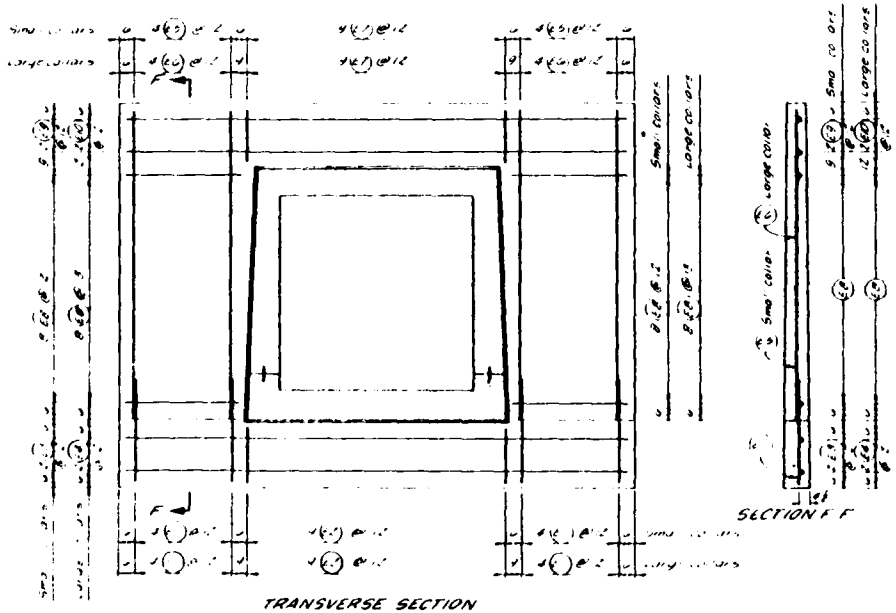


SECTION E-E



DETAILS OF EXPANSION JOINTS 5 THROUGH 11

(Omit inside plates at joint 5)



TRANSVERSE SECTION

SECTION F-F

REINFORCING DETAILS OF ANTISEEP COLLARS

NOTE SEE SHEET 22 FOR STEEL SCHEDULE FOR ANTISEEP COLLARS

0 1 2 3 4
Scale in feet

STRUCTURE C-3

DETAILS OF ANTISEEP COLLARS AND EXPANSION JOINTS
GRINDSTONE-LOST MUDDY CREEK WATERSHED PL 566, DEKALB CO., MO

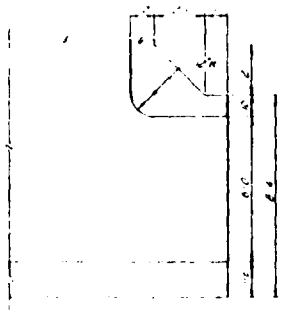
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed M.G.B.
Drawn D.J.R.
Traced
Checked

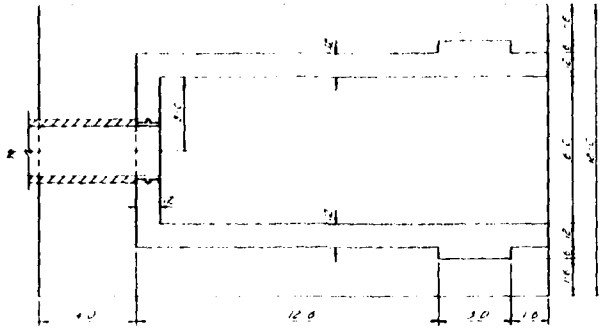
Date
No. Revision
Date

Sheet No. 40
S. E. 26, 993

PLATE C-11



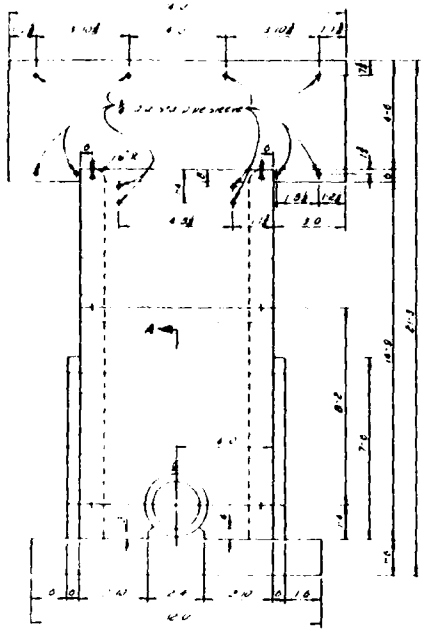
PARTIAL SECTION A-A



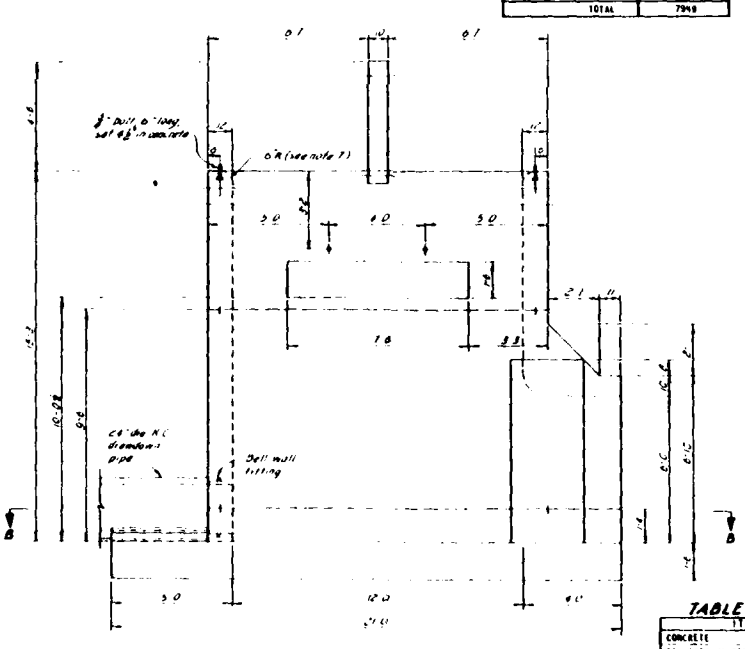
SECTION B-B

STEEL TOTALS

SIZE	LENGTH(FEET)	WEIGHT(LBS)
8	306-0	266
5	3170-6	3307
6	1133-6	1703
7	1308-6	2675
	TOTAL	7949

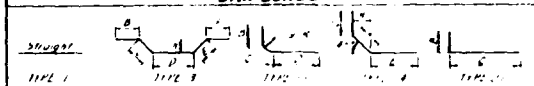


UPSTREAM ELEVATION



SIDE ELEVATION

BAR BENDS



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	L	W	T	T	H
F1	8	21	11-6	241-6	1						
F2	8	12	20-6	246-0	1						
F3	7	52	9-7	507-0	21	9 2	5 0				
F4	6	8	9-0	72-0	21	6 0	5 0				
F5	7	8	8-9	70-0	21	6 1	6 9				
F6	7	8	5-3	31-6	21	1 0	4 3				
F7	8	12	20-6	246-0	1						
F8	8	21	11-6	241-6	1						
F9	7	6	10-3	61-6	21	4 5	7-9				
F10	6	6	6-3	25-0	3	1-5	0-11	1-10	0-10	1-9	0 6 1/2
F11	6	6	7-0	16 6	1						
F12	5	32	3-6	112 0	1						
F13	8	8	7-6	60 0	1						
F14	6	8	7-0	56-0	1						
F15	8	6	16-6	99 0	1						
F16	8	6	2-3	8-0	1						
F17	5	6	8-6	30-0	1						
F18	8	16	9-9	156 0	1						
F19	8	16	8-6	136-0	1						
F20	8	30	16 8	330 0	1						
F21	5	13	13-0	156-0	1						
F22	7	2	2-3	4-6	1						
F23	8	8	7-0	56 0	1						
F24	5	6	9-0	54 0	21	6 10	1 2	3-0			
F25	6	10	7-0	70 0	1						
F26	5	2	8-6	17 0	1						
F27	8	6	9-9	58-6	1						
F28	8	22	9-8	214-4	1						
F29	7	30	8-6	255-0	1						
F30	8	2	4-9	9 6	1						
F31	6	2	11-0	88 0	21	5 0	6-0				
F32	6	2	11 2	22 6	21	5 2	6 1				
F33	6	2	10-6	21 0	21	5 0	5 6				
F34	6	8	10-6	84 0	21	5 2	5 9				
F35	6	4	10-3	41 0	21	5 6	5-9				
F36	7	12	12-9	229 6	21	5 0	7-9				
F37	8	16	12-6	125-0	21	4 9	7-9				
F38	8	22	7-9	170 6	1						
F39	6	12	6-3	75 0	3	1-5	0-10	1-10	0-10	1-9	0 6 1/2
F40	6	1	6-3	6 6	3	1-3	0-10	1-10	0-10		0 6 1/2
F41	6	8	6-2	52 0	16		2-6	2-1	0-11		2 7
F42	6	8	15-9	126 0	21	6 8	9-6				
F43	6	8	15-0	120 0	21	6 8	8-10				
F44	6	8	15-0	120 0	21	6 8	8-6				
F45	6	8	17-6	140 0	21	6 8	7-10				
F46	6	8	12-6	100 0	21	4 9	7-9				
F47	6	2	6-0	12 0	1						
F48	6	20	5-3	110-0	1						
F49	6	8	5-3	53 0	1						
F50	6	12	7-0	84 0	1						
F51	6	12	13-8	164 0	1						
F52	6	2	5-0	10 0	1						
F53	6	26	6-6	156 0	1						
F54	6	16	5-9	92 0	1						
F55	6	24	12-6	300 0	21	6 8	7-8				
F56	6	10	7-0	70 0	21	3 11	7-10				
F57	6	4	7-8	30 8	1						
F58	6	24	6-6	156 0	1						
F59	6	12	13-8	163 0	1						

6 - 3/4" X 6" GALVANIZED STEEL BOLTS COMPLETE WITH NUTS AND LOCK WASHERS REQUIRED

NOTES:

1. CHAMFER ALL EXPOSED EDGES 3/4"
2. BAR DIMENSIONS ARE OUT TO OUT OF BAR
3. RADIUS OF BENDS EQUAL THREE BAR DIAMETERS
4. USE 2" AND 3" DIMENSIONS TO REINFORCING BARS FROM FACE OF CONCRETE DESIGNATE THE CLEAR DISTANCE.
5. FOR DETAILS OF SLIDE GATE SEE SHEET 32
6. FOR DETAILS OF SHEAR PLATE CONSTRUCTION JOINT SEE SHEET 10 OR 34
7. ELIMINATE CURVE AT TOP OF INLET LOCALLY TO ALLOW PLACEMENT OF WALL BRACKET OF GATE ASSEMBLY.

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE	CU YD	90 15
REINFORCING STEEL	LBS	7949

0 1 2 3 4
Scale in feet

STRUCTURE C-3

DETAILS OF INLET STRUCTURE

GRINDSTONE-LOST-MUDDY CREEK

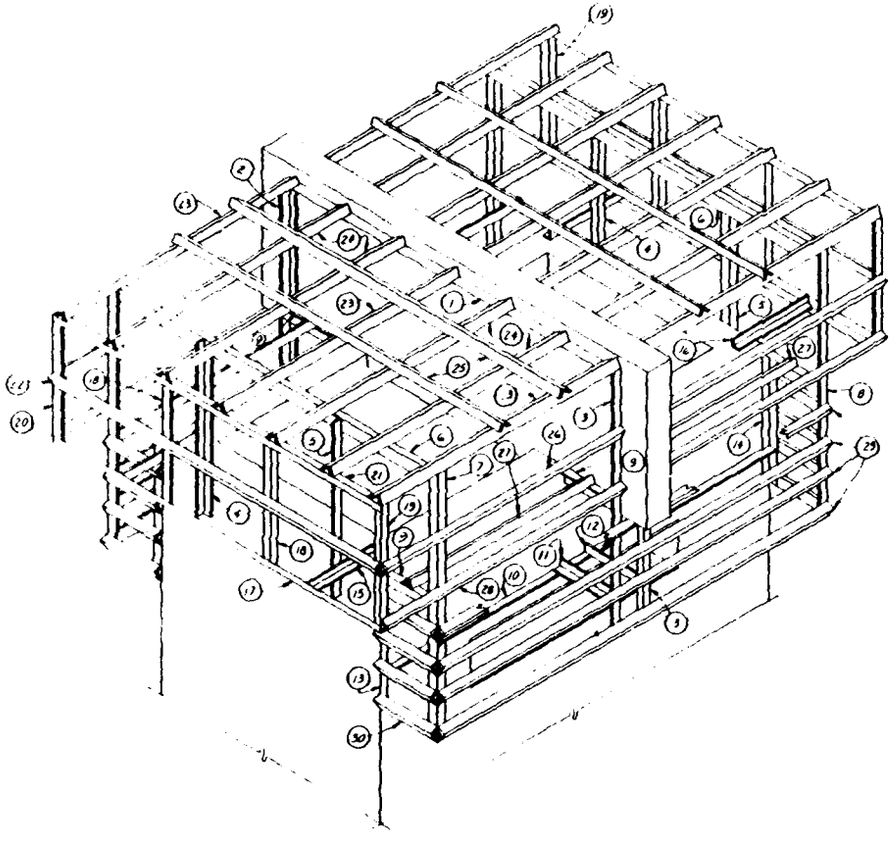
WATERSHED PL 566, DEKALB, CO., MO.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed [illegible]
Drawn [illegible]
Traced [illegible]
Checked [illegible]
Date [illegible]

S.C. 26,983

PLATE C-12



ISOMETRIC VIEW OF
INLET TRASH RACK

0 1 2 3 4
Scale in feet

MATERIAL LIST

MARK	ITEM	QUANTITY
1	ANGLE 3" X 3" X 3/8" 12'-0" LONG	2
2	ANGLE 3 1/2" X 3" X 3/8" 8'-2" LONG	2
3	ANGLE 3 1/2" X 3" X 3/8" 8'-2" LONG	2
4	ANGLE 3" X 3" X 3/8" 5'-6" LONG	2
5	ANGLE 3" X 3" X 3/8" 5'-6" LONG	2
6	CHANNEL 5" X 6 1/2" 12'-0" LONG	4
7	ANGLE 3" X 3" X 3/8" 8'-2" LONG	2
8	ANGLE 3" X 3" X 3/8" 8'-2" LONG	2
9	ANGLE 3" X 3" X 3/8" 1'-11 7/8" LONG	8
10	ANGLE 3" X 3" X 3/8" 12'-0" LONG	2
11	ANGLE 3" X 3" X 3/8" 1'-11 5/8" LONG	2
12	ANGLE 3" X 3" X 3/8" 1'-11 5/8" LONG	2
13	ANGLE 3" X 3" X 3/8" 9'-2" LONG	2
14	ANGLE 3" X 3" X 3/8" 9'-2" LONG	2
15	ANGLE 3" X 3" X 3/8" 2'-8" LONG	2
16	ANGLE 3" X 3" X 3/8" 2'-8" LONG	2
17	ANGLE 3" X 3" X 3/8" 12'-0 3/4" LONG	2
18	ANGLE 3" X 3" X 3/8" 3'-11 1/4" LONG	4
19	ANGLE 3" X 3" X 3/8" 3'-11 1/4" LONG	2
20	ANGLE 3" X 3" X 3/8" 3'-11 1/4" LONG	2
21	ANGLE 3" X 3" X 3/8" 12'-0 3/4" LONG	2
22	ANGLE 3" X 3" X 3/8" 12'-0 3/4" LONG	2
23	ANGLE 3 1/2" X 3 1/2" X 3/8" 8'-7" LONG	4
24	ANGLE 3 1/2" X 3 1/2" X 3/8" 8'-7" LONG	8
25	ANGLE 3" X 3" X 3/8" 12'-0" LONG	4
26	ANGLE 3 1/2" X 3 1/2" X 3/8" 8'-7" LONG	4
27	ANGLE 3" X 3" X 3/8" 6'-7" LONG	4
28	ANGLE 3" X 3" X 3/8" 8'-7" LONG	4
29	ANGLE 3" X 3" X 3/8" 10'-0 3/4" LONG	8
30	ANGLE 3" X 3" X 3/8" 2'-0 1/8" LONG	16
31	ANGLE 3" X 3" X 3/8" 0'-3" LONG	4
	1/2" BOLTS, NUTS AND FLAT WASHERS, 3 1/2" LONG, ALUMINUM	112
	1/2" BOLTS, NUTS AND FLAT WASHERS, 2 1/2" LONG, ALUMINUM	70
	1/2" COUNTERSUNK BOLTS, NUTS AND FLAT WASHERS, 2 1/2" LONG, ALUMINUM	4
	5/8" BOLTS, NUTS AND FLAT WASHERS, 12" LONG, GALV STEEL	16

WEIGHT OF ALUMINUM 1,870 LBS

NOTES:
1. TRASH RACK TO BE FABRICATED OF ALUMINUM
2. ALUMINUM MEMBERS TO BE BOLTED TOGETHER WITH 1/2" ALUMINUM BOLTS, NUTS AND FLAT WASHERS, UNLESS OTHERWISE SPECIFIED
3. ALL BOLT HOLES TO BE DRILLED 5/8" DIAMETER UNLESS OTHERWISE SPECIFIED

STRUCTURE C-3

DETAILS OF INLET AND ORIFICE TRASH RACK

GRINDSTONE LOST MUDDY CREEK

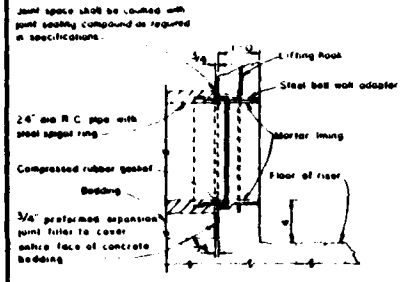
WATERSHED PL 566, DEKALB CO., MD

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.E.T. 2-69
Drawn D.A.J. 2-69
Traced
Checked M.E.R.

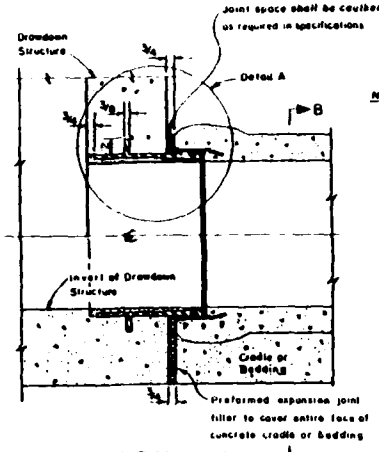
S.C. 26,993

PLATE C-13



SECTION ON ℄

Not to scale



SECTION A-A

Notes for Spigot Wall Adapter and Bell Wall Adapter

1 To permit a good concrete bond, steel and mortar surfaces shall be thoroughly cleaned

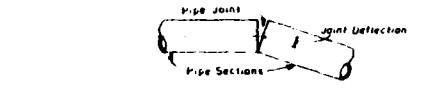
2 Spigot wall adapter (Steel ring with mortar) to be furnished by the Manufacturer The adapter and installation will be considered as incidental to the payment for pipe conduit

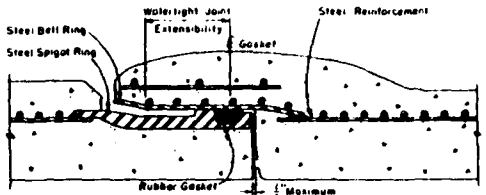
Notes for Pipe Joints

1 For pipe lengths other than those shown, joint requirements will be determined by the Engineer

2 Where pipe sections of different lengths are connected in the same structure, all sections shall meet the joint requirements of the longest section

3 Where the pipe furnished has an outside diameter greater than that called for on the plans, the three-edge bearing strength of the pipe furnished must be equal to or greater than the three-edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter specified Shown on sheets

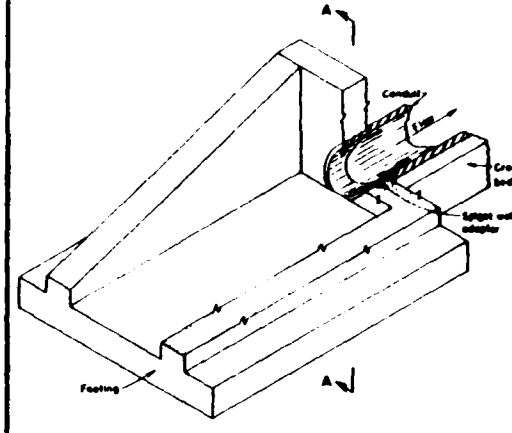




Joint Requirements for Various Pipe Lengths

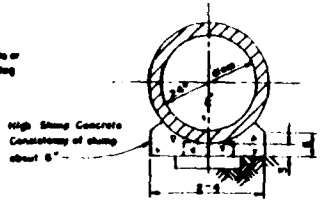
Structure	Pipe Diam	Pipe Lengths	Minimum Watertight Joint Extensibility	Minimum Allowable Joint Deflection
Drawdown	24	8	2 75	---
Drawdown	24	4	2 00	---

DETAIL OF PIPE JOINT FOR STEEL BELL AND SPIGOT

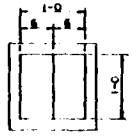


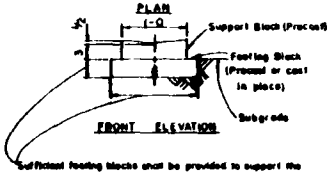
ISOMETRIC VIEW

(Showing Spigot Wall Adapter installed in downstream wall of Drawdown Structure)



SECTION B-B





Sufficient footing blocks shall be provided to support the pipe to the line and grade as shown on the General Layout Drawing Required size, number and reinforcement (if desired) to be determined by the Contractor Fabrication and installation of footing blocks is incidental to the item of "Pipe Conduit"

DETAILS OF CONCRETE BLOCKS

0 1 2

Scale in Feet

STRENGTH REQUIREMENTS FOR REINFORCED CONCRETE PIPE CONDUITS

The pipe shall be designed and manufactured to safely withstand the internal pressure and external load specified in the table below

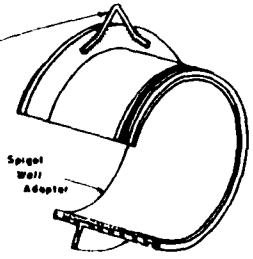
Structure	Outside Pipe Diameter (Inches)	Inside Pipe Diameter (Inches)	INTERNAL PRESSURE (Hydrostatic) Head of Water (Feet)	EXTERNAL LOAD Applicable Standard Specifications AWWA C 301	AWWA C 300 C 302 ASTM C 361
				Pounds per linear foot of pipe under the 3-edge bearing** method to produce:	
				0 001 inch crack one foot long	0 01 inch crack one foot long
Drawdown	30	24	191	330	800

** Three-edge-bearing supporting strength is based upon the resulting strength as determined by the three edge-bearing test described in ASTM Designation C 497

DETAIL OF SPIGOT WALL ADAPTER

STEEL RING

Lifting Hook – ½" round bar may be welded to steel ring as shown to facilitate handling



PERSPECTIVE VIEW

(Spigot Wall Adapter)

STRUCTURE C-3

DETAILS OF SPIGOT WALL ADAPTER AND PIPE JOINT AND STRENGTH REQUIREMENTS

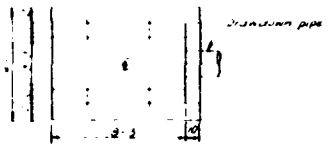
GRINDSTONE-LOST-MUDDY CREEK

WATERSHED PL 566, DEKALB CO, MO

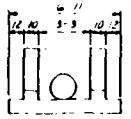
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed
Drawn
Traced
Checked
Date
Approved
Title
Scale
Drawing No 5,E-26, 993

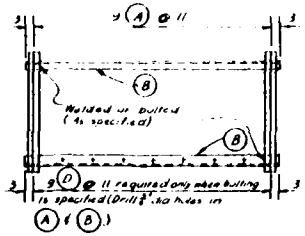
PLATE C-14



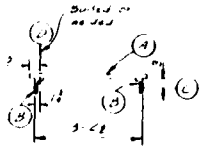
PLAN VIEW



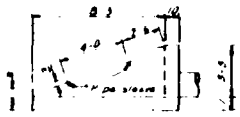
UPSTREAM ELEVATION



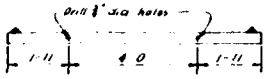
PLAN



END VIEW



SIDEWALL ELEVATION



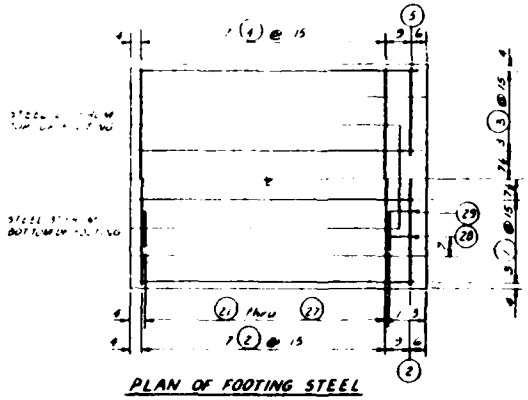
SIDE VIEW

TRASH RACK MATERIAL LIST

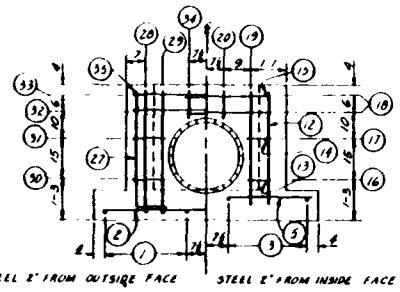
MARK	ITEM	QUANTITY
A	L 2 X 2 X 1/4 3'-9" LONG	9
B	L 5 X 3 X 3/8 7'-10 LONG	2
C	BOLT - 5/8" DIA. 11 1/2" LONG	4
D (REQUIRED ONLY WHEN BOLTING IS SPECIFIED)	BOLT - 5/8" DIA. 2 3/4" LONG	18
	PIPE SLEEVE - 3/4" DIA., STD., GALV., 10" LONG	4

BOLTS SHALL BE GRADE A, GALV., WITH HEX NUT AND STD. WASHER.

WT. OF ALUMINUM = 80 LBS

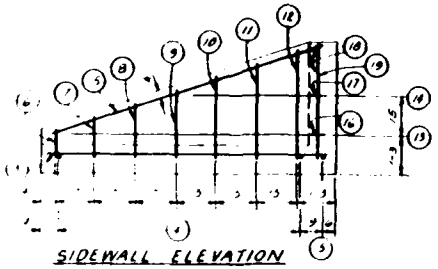


PLAN OF FOOTING STEEL

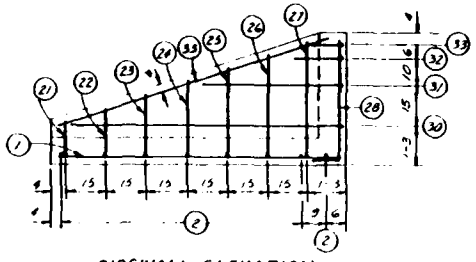


STEEL 2" FROM OUTSIDE FACE STEEL 2" FROM INSIDE FACE

ENDWALL ELEVATION



SIDEWALL ELEVATION



SIDEWALL ELEVATION

STEEL 2" FROM OUTSIDE FACE
STEEL 3" FROM BOTTOM OF FOOTING

MATERIAL AND FABRICATION

(Check appropriate block)

1 TRASH RACK SHALL BE CONSTRUCTED FROM:
- ☐ STRUCTURAL STEEL
- ☐ ALUMINUM ALLOY

2 RACK SHALL BE:
- ☐ BOLTED
- ☐ WELDED

3 STRUCTURAL STEEL SHALL BE:
- ☐ GALVANIZED ☐ UNCOATED
- ☐ PAINTED

GALVANIZING OR PAINTING SHALL BE IN ACCORDANCE WITH SPECIFICATIONS.

CONSTRUCTION NOTES

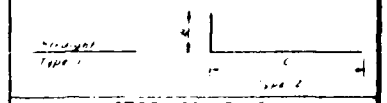
1 EXACT LOCATION OF BAR (29) NOT SHOWN PLACE TO CLEAR PIPE 2

QUANTITIES

CONCRETE CLASS M000	3.58 CU YDS
STEEL REINFORCEMENT	552 LBS

(TOTAL LENGTH OF #5 BARS = 292'-6" TOTAL LENGTH OF BARS (11) (17) (29) (30) (31) AND (39))

BAR BENDS



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	D	C
1	5	4	8'9"	52'6"	1		
2	5	8	6'6"	52'0"	1		
3	5	6	8'6"	51'0"	1		
4	5	7	6'6"	45'6"	1		
5	5	2	2'9"	5'6"	1		
6	5	2	0'9"	1'6"	1		
7	5	1	1'0"	1'0"	1		
8	5	2	1'6"	3'0"	1		
9	5	2	2'0"	4'0"	1		
10	5	2	2'3"	4'6"	1		
11	5	2	2'9"	5'6"	1		
12	5	1	3'3"	3'3"	1		
13	5	2	4'0"	8'0"	1		
14	5	2	4'3"	8'6"	1		
15	5	2	8'9"	17'6"	1		
16	5	2	0'6"	1'0"	1		
17	5	2	0'9"	1'6"	1		
18	5	2	4'0"	8'0"	1		
19	5	2	3'6"	7'0"	1		
20	5	2	0'9"	1'6"	1		
21	5	2	2'3"	4'6"	2	1'6"	1'3"
22	5	2	2'6"	5'0"	2	1'5"	1'1"
23	5	2	3'0"	6'0"	2	1'10"	1'2"
24	5	2	3'6"	7'0"	2	2'3"	1'3"
25	5	2	3'9"	7'6"	2	2'8"	1'1"
26	5	2	4'3"	8'6"	2	3'1"	1'2"
27	5	2	4'9"	9'6"	2	3'6"	1'3"
28	5	2	5'0"	10'0"	2	3'8"	1'3"
29	5	2	5'0"	10'0"	2	3'8"	1'3"
30	5	2	5'6"	11'0"	2	1'0"	0'6"
31	5	2	5'6"	11'0"	2	1'0"	0'6"
32	5	2	4'6"	9'0"	2	1'6"	3'0"
33	5	2	3'9"	7'6"	2	0'9"	3'0"
34	5	2	0'9"	1'6"	1		
35	5	2	8'9"	17'6"	1		

STRUCTURE C 3

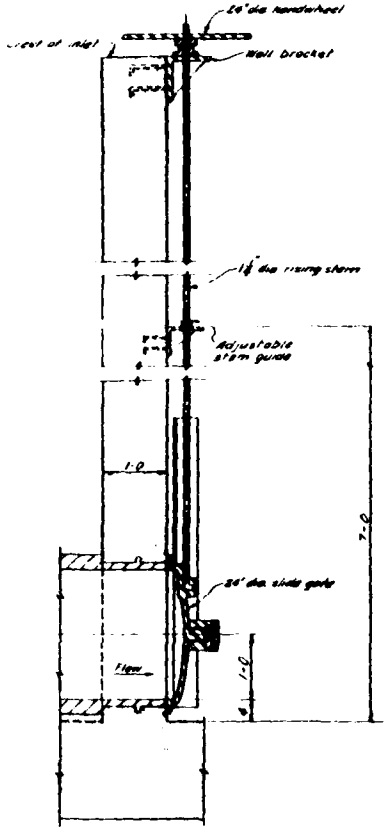
DRAWDOWN STRUCTURE
FOR 24" DIA R C PIPE
GRINDSTONE LOST MUDDY CREEK
WATERSHED PL 566, DEKALB CO., MO
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

S.C.S.-ENG-###

B W P UNIT - DESIGN SECTION
LINCOLN, NEBRASKA

DATE APPROVED March 3, 1969

PLATE C-15



DETAILS OF SLIDE GATE

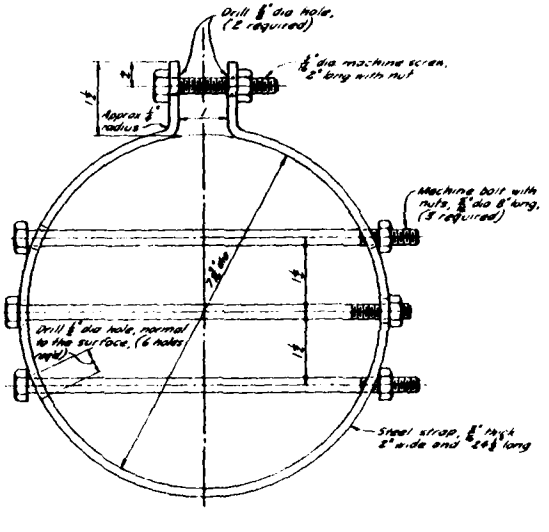
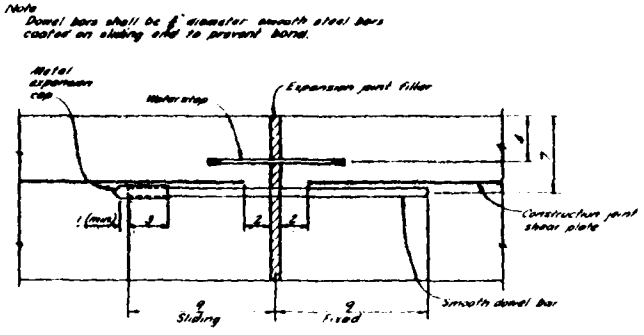


TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
SER., HEAD MACHINE SCREW 5/16" DIA., 2" LONG WITH NUT	EACH	1
MACHINE BOLT, 5/16" DIA., 8" LONG, WITH NUTS	EACH	3
STEEL STRAP, 3/16" x 2", 26 1/2" LONG	EACH	1

DETAIL OF ANIMAL GUARD FOR 6" DIA. ASBESTOS-CEMENT PIPE



SECTION OF CONSTRUCTION JOINT SHOWING DOWEL BAR

STRUCTURE C-3

DETAILS OF ANIMAL GUARD AND SLIDE GATE

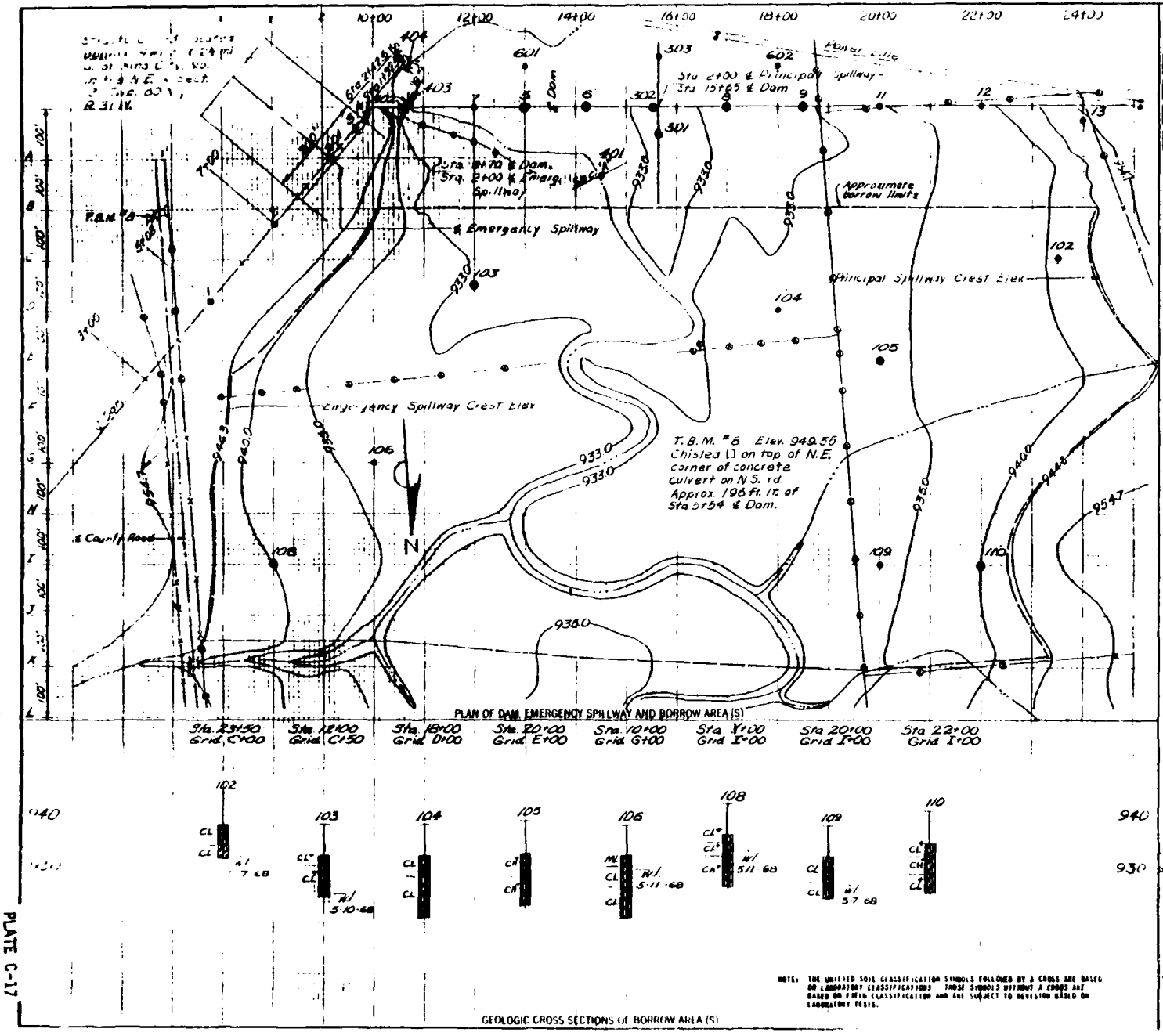
GRINDSTONE-LOST-MUDDY CREEK

WATERSHED PL 566, DEKALB, CO., MO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed S.F.C.
Drawn
Traced
Checked C.J.
Date
Approved by
Title
Scale
Drawing No. 5,E-86,998

PLATE C-16



PLAN OF DAM, EMERGENCY SPILLWAY AND BORROW AREA (S)

GEOLOGIC CROSS SECTIONS OF BORROW AREA (S)

NOTE: THE UNIFIED SOIL CLASSIFICATION SYMBOLS FOLLOWED BY A CROSS ARE BASED ON LABORATORY CLASSIFICATIONS. THOSE SYMBOLS WITHOUT A CROSS ARE BASED ON FIELD CLASSIFICATION AND ARE SUBJECT TO REVISION BASED ON LABORATORY TESTS.

LEGEND

SYMBOLS

UNCONSOLIDATED MATERIAL

CONSOLIDATED MATERIAL

Sedimentary Rocks

Metamorphic Rocks

Igneous Rocks

Undifferentiated

Other Symbols

- hole logged only
- hole sampled
- strike and dip
- bit or trench

Abbreviations

ang	angular	lam	laminated	G	gravel, gravelly
bld	boulders (> 12")	lse	loose	S	sand, sandy
calc	calcareous	mas	massive	Si	silt, silty
calc	calcite	med	medium	C	clay, clayey
Cly	clayey	mic	micaceous	O	organic
cmtd	cemented	mod	moderately	W	well graded
cse	coarse	nr	no recovery	P	poorly graded
cbl	cobbles (3" 12")	per	permeable		
Cpct	Compact	poo	poorly		
conc	concretions	rnd	rounded		
cry	crystalline	sli	slightly		
dns	dense	sft	soft		
dpsd	deposited	stf	stiff		
dmtd	disintegrated	stky	sticky		
fn	fine	stn	stain		
frac	fractured	SS	Slow Seepage		
frag	fragments	ss	subhorizontal		
frm	friable	sv	subvertical		
gnd	gneiss	vry	very		
gran	granular	wk	weak		
hd	hard	wthd	weathered		
hvy	heavy	WL	Water static, water level		

TEST HOLE NUMBERING SYSTEM

Centerline of dam	1	99	Spillway channel	401	499
Borrow area	101	199	Auger holes	501	599
Emergency spillway	201	299		601	699
Centerline of outlet structure	301	399		701	799

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

GW	Well graded gravels, gravel sand mixtures
GP	Poorly graded gravels
GM	Silty gravels, gravel sand silt mixtures
GC	Clayey gravels, gravel sand clay mixtures
SW	Well graded sands, sand gravel mixtures
SP	Poorly graded sands
SM	Silty sand
SC	Clayey sands, sand clay mixtures
ML	Silts with liquid limit of 50 or less
MH	Silts with liquid limit above 50
CL	Clays with liquid limit of 50 or less
CH	Clays with liquid limit above 50
OL	Organic silts and clays with liquid limit of 50 or less
OH	Organic silts and clays with liquid limit above 50

Revised February 1967

CROSS SECTIONS — PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS

STRUCTURE C-3

GRINDSTONE-LOST MUDDY CREEK WATERSHED

PL 566 GENTRY & DEKALB CO. MO

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

St. Mo. 9-69

PLATE C-17

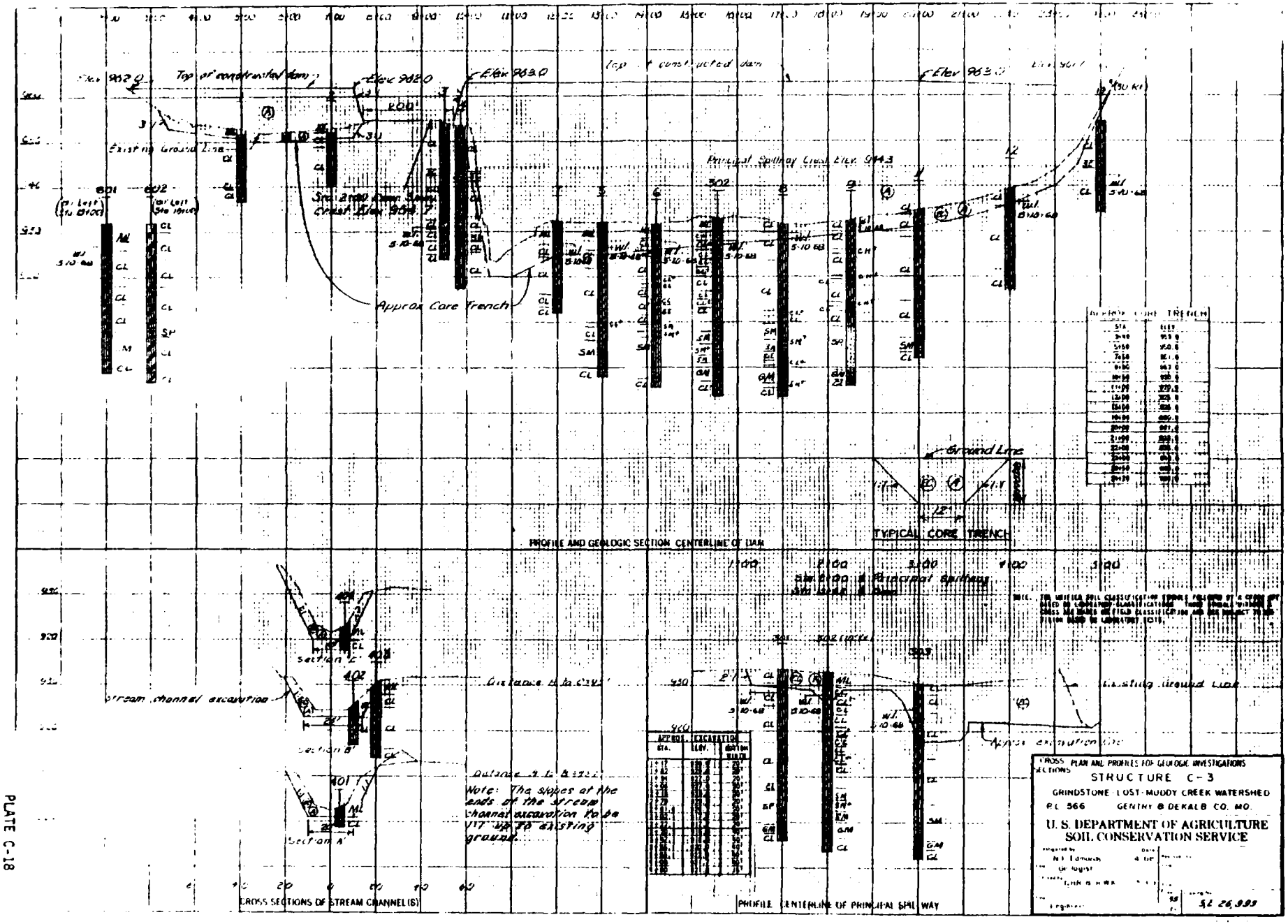
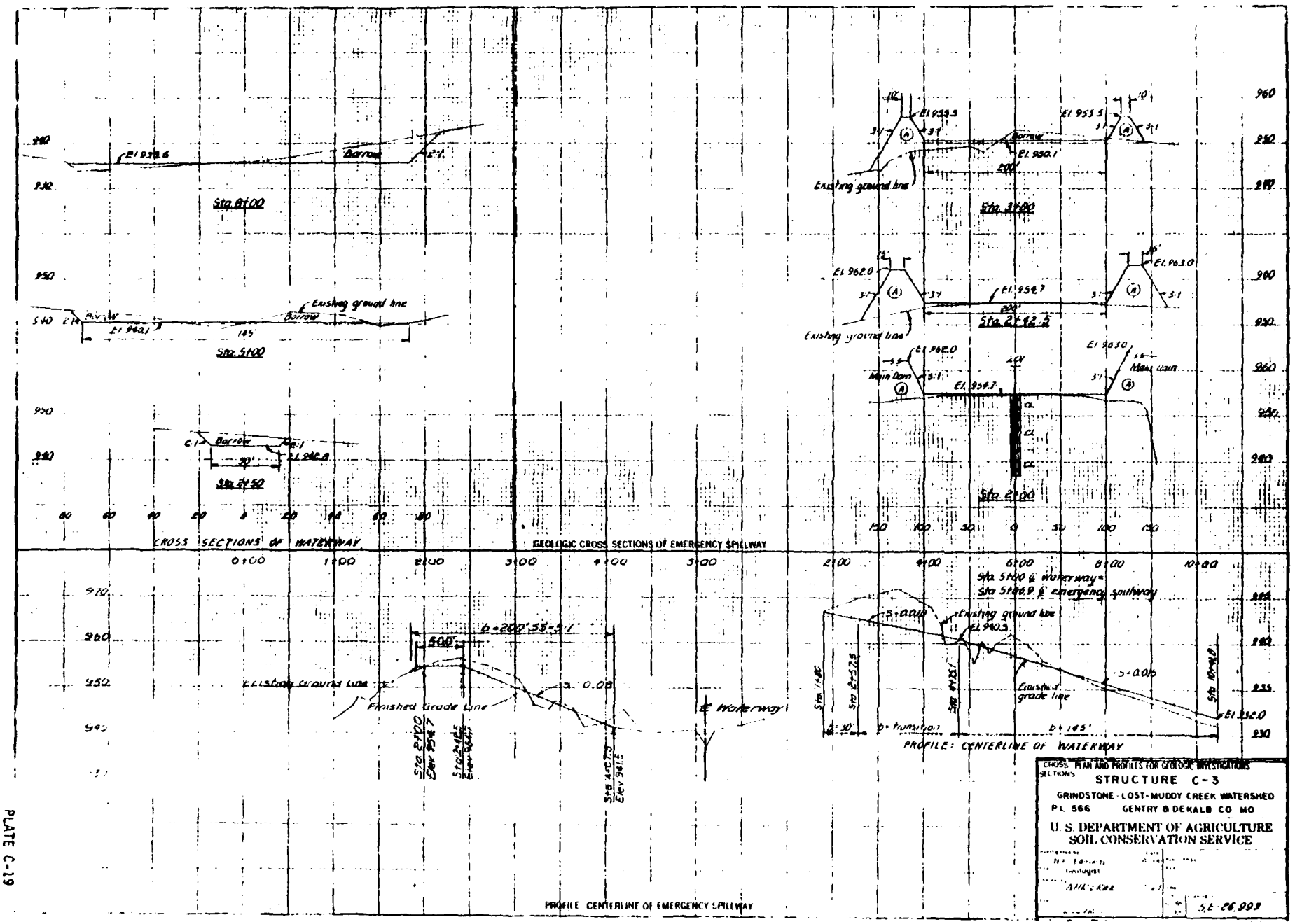

PROFILE AND GEOLOGIC SECTION CENTERLINE OF DAM
TYPICAL CORE TRENCH
CROSS SECTIONS OF STREAM CHANNEL (S)
PROFILE CENTERLINE OF PRINCIPAL SPILLWAY
Top of constructed dam
Elev 982.0
Elev 983.0
Existing Ground Line
Approx Core Trench
Principal Spillway Crest Elev 944.3
Ground Line
Stream channel excavation
Section A
Section B
Section C
Distance ℄ to ℄ Dam
Distance ℄ to ℄ Spillway
Existing Ground Line
Approx excavation line
Note: The slopes of the ends of the stream channel excavation to be 1V:3H to existing ground.
CROSS PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
SECTIONS
STRUCTURE C-3
GRINDSTONE-LOST-MUDDY CREEK WATERSHED
P.L. 566 GENTRY & DEKALB CO. MO.
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SL 26,999

PLATE C-18



CROSS SECTIONS PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS

STRUCTURE C-3

GRINDSTONE-LOST-MUDDY CREEK WATERSHED

PL 566 GENTRY & DEKALB CO MO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

S.E. 26,993

PLATE C-19

STRUCTURE DATA

Class of Structure: 6

Drainage Area (total): ____ Ac. 19.0 Sq.Mi.

(uncontrolled): ____ Ac. 19.0 Sq.Mi.

Time of Concentration: 34 Hours

Soil Cover Complex Number: 79 For A.M.C. II

Sediment Capacity Available: 618 Ac.Ft. below Elev. 944.3

Total Sediment Capacity Available: 618 Ac.Ft.

Capacity Equivalents (Vol.): 0.61 In.

Retarding Capacity Provided: 3,480 Ac.Ft.

Capacity Equivalents (Vol.): 3.43 In.

Water Supply Provided: 675 Ac.Ft.-Identify Uses
Recreation

Principal Spillway:

Maximum Capacity (low stage): 230 c.f.s.

Maximum Capacity (high stage): 864 c.f.s.

10 Day Drawdown Elev.: 944.8

Emergency Spillway:

Percent Chance Use: 2 Storm Duration: 6 hr.

Type: Earth "n" Value Used: 0.04

Emergency Spillway Hydrograph for Class: b Structures

Rainfall: 8.01 in.

Runoff: 5.52 in.

Peak Inflow: 14,100 c.f.s.

Maximum Discharge - Emergency Spillway: 3,000 c.f.s.

Maximum Water Surface Elev.: 957.17

Velocity of Flow (Ve): 10.5 f.p.s.

Supplementary Data and Special Design Features:

Freeboard Hydrograph for Class: b Structures

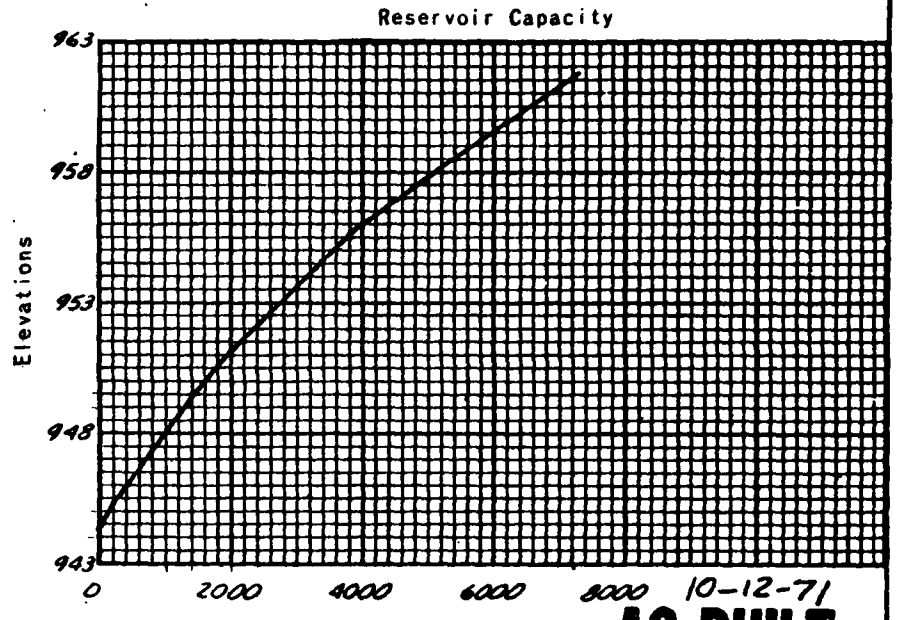
Rainfall: 13.86 in.

Runoff: 11.10 in.

Peak Inflow: 27,600 c.f.s.

Maximum Discharge - Emergency Spillway: 17,400 c.f.s.

Maximum Water Surface Elev.: 961.7



10-12-71

AS BUILT

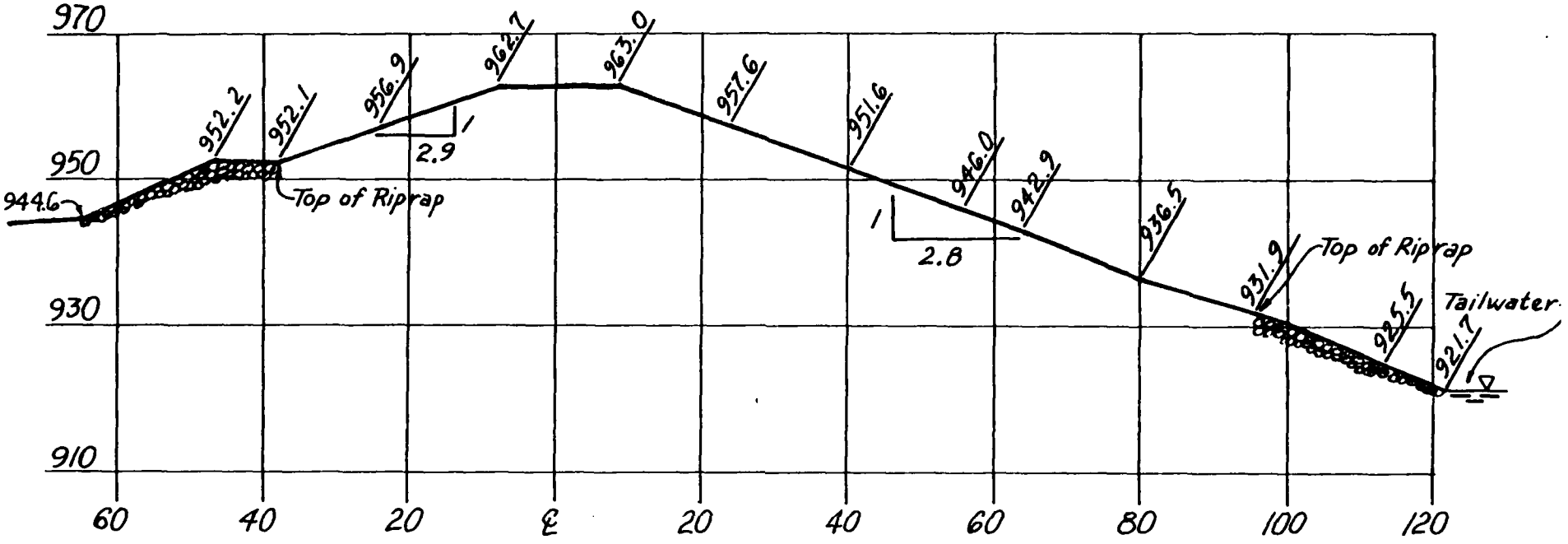
STRUCTURE C-3

Supplementary Data and Special Design Features:

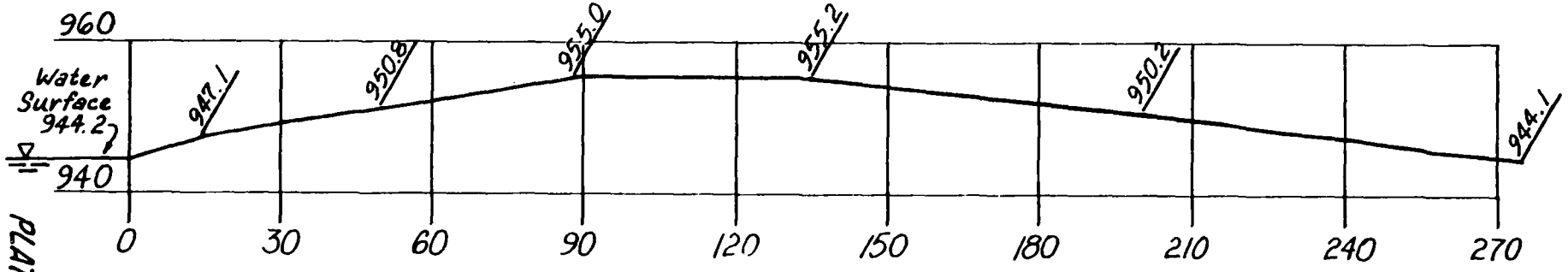
STRUCTURE DATA
GRINDSTONE LOST MUDDY CREEK
WATERSHED P.L. 566, DEKALB CO., MO.
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed | Date | Approved by
Drawn | Title
Traced | Date
Checked | Sheet No. 1 of 1 | Drawing No. 5-E-26,993A

PLATE C-20

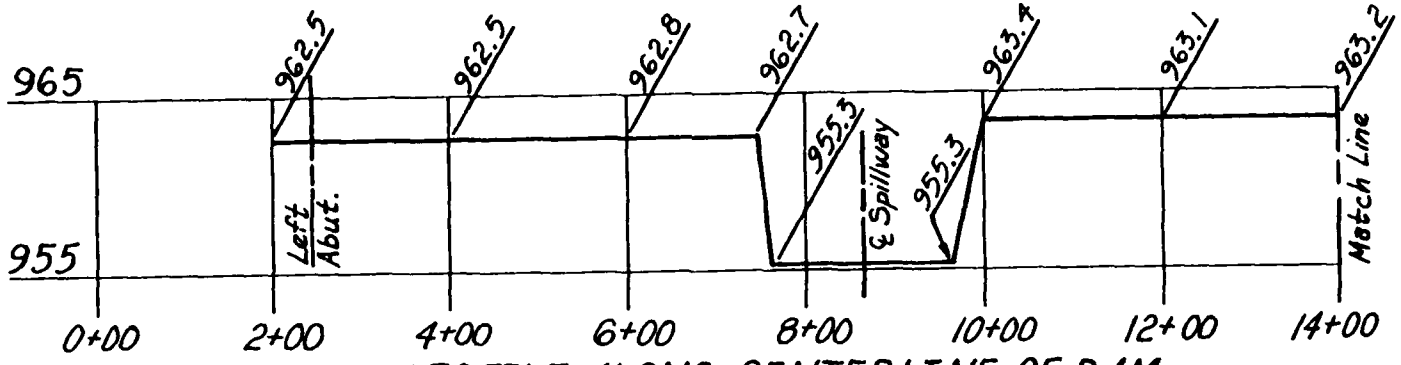


MAXIMUM SECTION OF DAM AT STA. 15+60
(AS MEASURED BY INSPECTION TEAM)
Scale: 1"=20'H; 1"=20'V



CENTERLINE PROFILE OF EMERGENCY SPILLWAY
(AS MEASURED BY INSPECTION TEAM)
Scale: 1"=30'H; 1"=20'V

PLATE C-21



PROFILE ALONG CENTERLINE OF DAM
(AS MEASURED BY INSPECTION TEAM)
Scale: 1" = 200'H; 1"=10'V

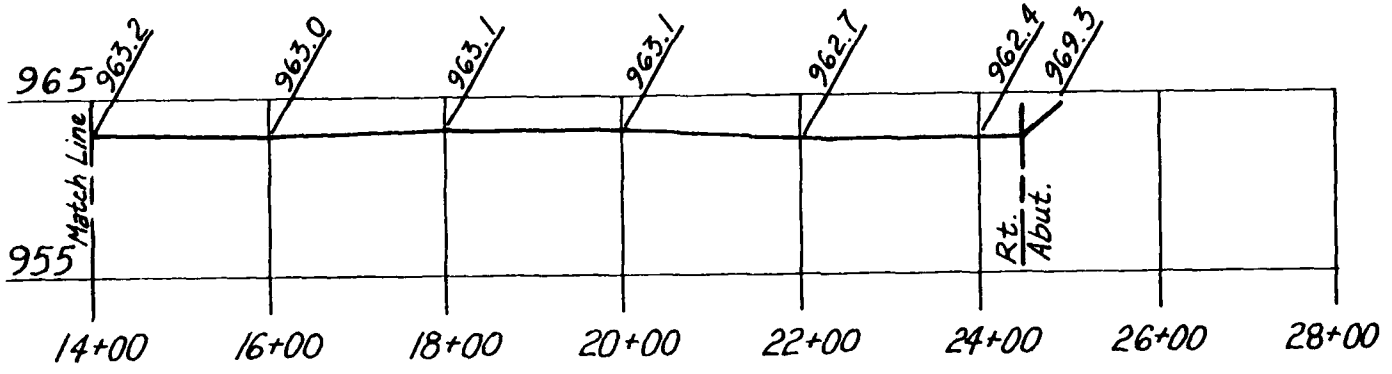


PLATE C-22

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See this Appendix).

   a. Forty-eight hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Chillicothe, MO. as supplied by the St. Louis District, Corps of Engineers per a hydrologic/hydraulic training session on 30 April, 1980. The forty-eight hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology. The rainfall distribution as described by EM 1110-2-1411 (Standard Project Storm) was used in distributing the rainfall.

   b. Drainage area = 19.0 square miles (12,160 acres).

   c. Time of concentration of runoff = 3.4 hours (taken from "as-built" plans). Time of concentration was verified using the "Kirpich" formula - $Tc = 0.0001299 \; L^{1.15} / \Delta H^{0.38}$

      Where L = main channel length from the outflow point to the upstream watershed boundary, in feet = 40,500
      ΔH = elevation difference between the outflow point and the upstream watershed boundary, in feet = 176

      Time of concentration for "Kirpich" was 3.62 hours; therefore, the SCS figure was assumed as accurate and used in the routing computations.

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the riser. No antecedent storm was required due to the utilization of the forty-eight hour storm.

   e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 2.51 inches. The total losses for the PMF storm were 1.16 inches. These data are based on SCS runoff curve No. 91 and No. 79 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil groups Shelby (hydrologic group C) and Lagonda, Grundy, and Lamoni (hydrologic group D). The watershed

is approximately 80% in crops and 20% in pasture and wooded areas. The crops consist of row crops, small grain, and legumes with contour and terrace farming being practiced.

f. Average soil loss rates = 0.05 inch per hour approximately (for PMF storm, AMC III).

2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow over the top of the dam,

a. The principal spillway rating was developed as follows:

(1) Low stage weir flow equation ($Qw = CLH^{1.5}$)
where C = weir coefficient = 3.1 (SCS Engr. Memo 50)
L = length of weir, ft. = 15.0 (2 x 7.5)
H = total head, ft. = Pool elevation - 944.3

(2) Low stage orifice flow equation ($Qo = CA\sqrt{2gH}$)
where C = orifice coefficient = 0.6 (SCS T.R. 29)
A = area of opening, $ft.^2$ = 22.5 (2 orifices)
H = total head, ft. = Pool elevation - 945.05

(3) High stage weir flow equation ($Qw = CLH^{1.5}$)
where C = weir coefficient = 3.1 (SCS Engr. Memo 50)
L = length of weir, ft. = 34.33
H = total head, ft. = Pool elevation - 949.5

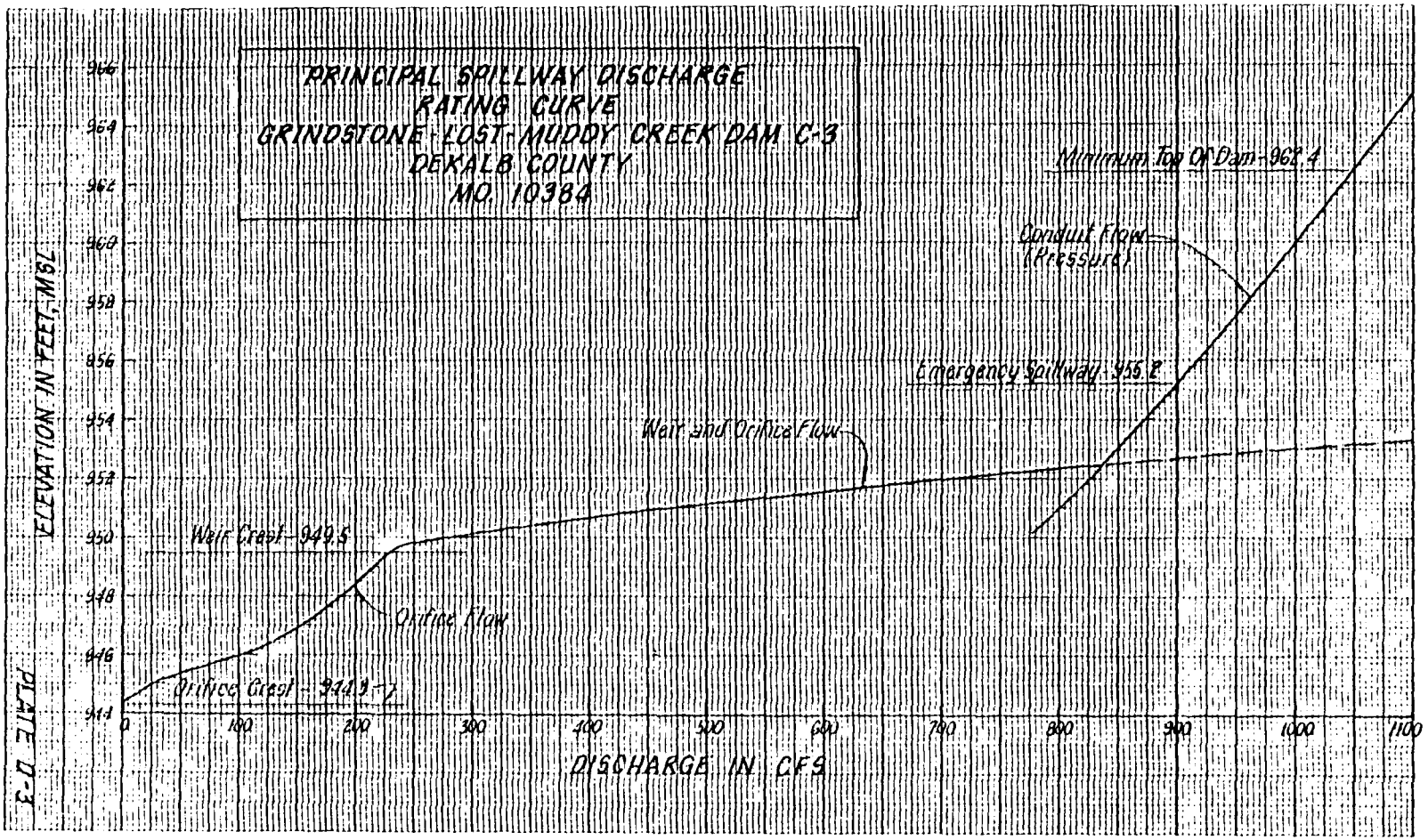
(4) Full conduit flow equation ($Qp = a\sqrt{\frac{2gh}{1 + Kr + Kplp}}$)
where a = area of conduit, $ft.^2$ = 36.0
Kr = coefficient for loss through riser = 0.7 (SCS Design Note 8)
Kp = coefficient for conduit friction loss = 0.00287 (ES-42, SCS NEH, Section 5)
lp = length of conduit, ft. = 128
h = total head = Pool elevation - 935.14

(Note: full conduit flow controls at or above pool elevation 953 $\pm$).

b. The emergency spillway rating was developed using the Corps of Engineers Water Surface Profiles HEC-2 computer program. Critical depth was assumed to occur just downstream of the control section of the spillway.

c. The flows over the dam were developed using the dam overtopping analysis (Flow over non-level dam crest) with the HEC-1 (Dam Safety Version) program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) Program to determine the capabilities of the spillway and dam embankment crest. The input, output, and plotted hydrographs are attached in this Appendix.


PRINCIPAL SPILLWAY DISCHARGE
RATING CURVE
GRINDSTONE-LOST-MUDDY CREEK DAM C-3
DEKALB COUNTY
MO. 10384
PLATE D-3
ELEVATION IN FEET, MSL
966
964
962
960
958
956
954
952
950
948
946
944
0
100
200
300
400
500
600
700
800
900
1000
1100
DISCHARGE IN CFS
Minimum Top Of Dam - 962.4
Conduit Flow (Pressure)
Emergency Spillway - 955.2
Weir and Orifice Flow
Weir Crest - 949.5
Orifice Flow
Orifice Crest - 944.9

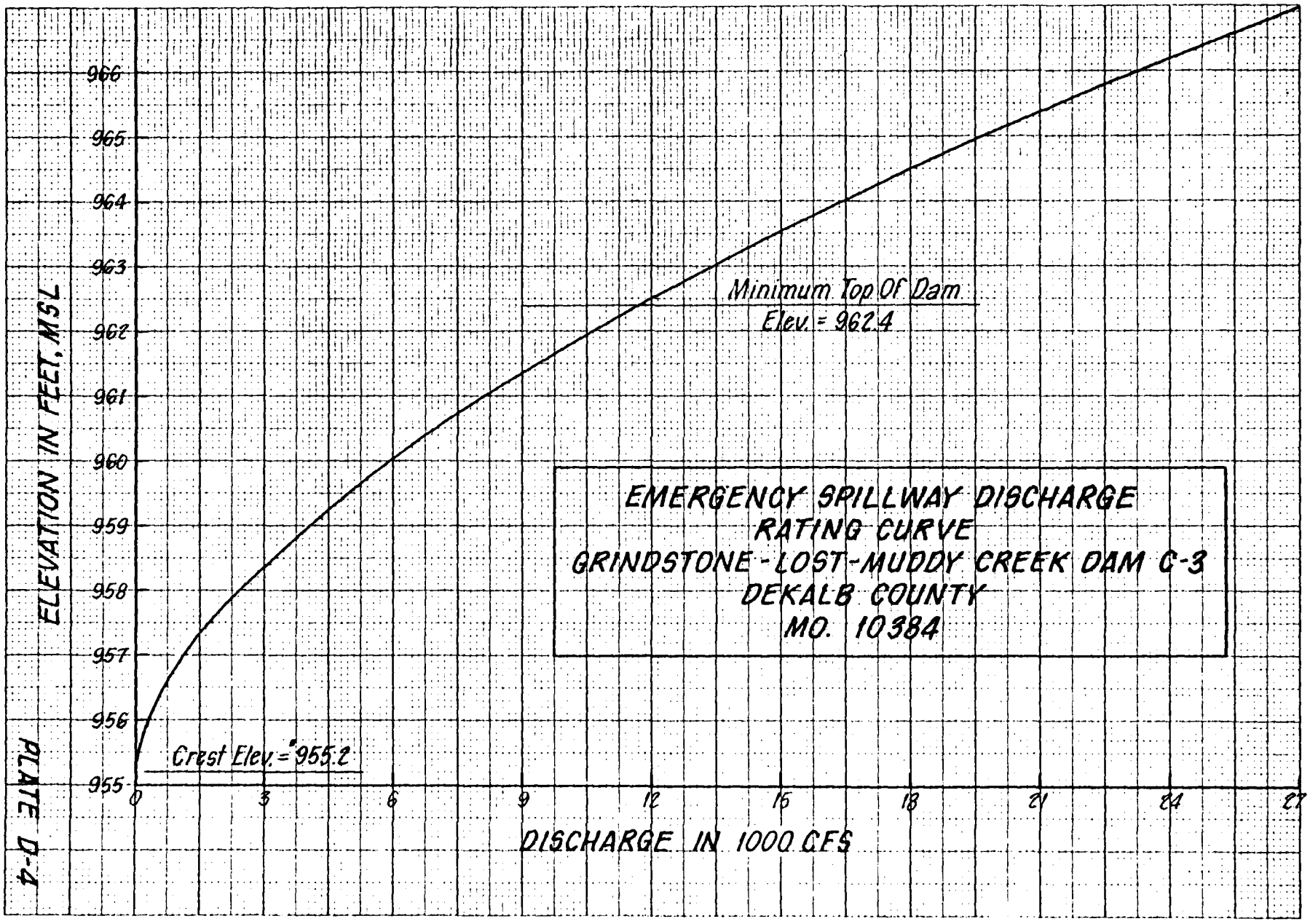


PLATE D-4

LISTING OF CARD INPUT DATA

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       H&H ANALYSIS OF SAFETY OF GRINDSTONE-LOST-MUDDY CREEK DAM C-3
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 0002880000000000000010                              000000000000000000000003
B1000005
J 0000010000000800000001
J1000.3000000.3500000.4000000.4500000.5000000.55000000.6000001.0
K 00000000000001                      000000000000000000000001
K1       CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 10384
M 0000010000000200019.0          000019.0000001.0                        00000001
P 000000000024.000000095000001130000012300000134
T                                                              -1.0   -91.0
W2       00002.04
X 000000     -.0100000001
K 00000100000002                      000000020000000000000001
K1       ROUTED FLOWS THRU RESERVOIR 10384
Y1                          0000000100000001
Y1000001                                                    -944.3       -1
Y40944.3000945.0000946.0000948.0000949.5000950.0000952.0000953.0000954.0000955.0
Y40956.0000957.0000958.0000959.0000960.0000961.0000962.0000963.0000964.0000965.0
Y5000000000000270000010300000188000002300000028000000707000008490000087300000895
Y500121800002039000033610000498200006902000090720001154100014361000173790002059 8
$S000000000012930000477300006063000085930000919300010393
$E000926000944.3000954.7000957.2000961.70000096300000965
$$ 944.3
$D0962.4000002.9000001.500001930
$L000000000002200000059000000805000014150000193500001935000019450000195000001960
$V0962.4000962.5000962.7000962.9000963.1000963.4000964.0000965.0000966.000000967
K 000099
A
A
A
A
A
```

PLATE D-5

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION    JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/07/16.
     TIME= 10.26.41.

          ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
          H&H ANALYSIS OF SAFETY OF GRINDSTONE-LOST-MUDDY CREEK DAM C-3
          RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

                                JOB SPECIFICATION
      NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT   IPRT   NSTAN
     288       0      10       0       0       0       0       0      3       0
                           JOPER     NWT   LROPT   TRACE
                               5       0       0       0

                        MULTI-PLAN ANALYSES TO BE PERFORMED
                              NPLAN= 1 NRTIO= 8 LRTIO= 1
          RTIOS=    .30    .35    .40    .45    .50    .55    .60   1.00

**********      **********      **********      **********      **********

                        SUB-AREA RUNOFF COMPUTATION

     CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 10384

                ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME  ISTAGE  IAUTO
                000001      0       0       0      0      0       1       0      0

                                HYDROGRAPH DATA
     IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
         1       2   19.00    0.00   19.00    1.00   0.000       0       1       0

                                PRECIP DATA
          SPFE     PMS      R6     R12     R24     R48     R72     R96
          0.00   24.00   95.00  113.00  123.00  134.00    0.00    0.00

                                LOSS DATA
     LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
         0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -91.00    0.00    0.00

     CURVE NO =  -91.00  WETNESS =   -1.00  EFFECT CN =   91.00

                            UNIT HYDROGRAPH DATA
                        TC=  0.00    LAG=  2.04

                            RECESSION DATA
                    STRTQ=    0.00    QRCSN=    -.01    RTIOR= 1.00

     UNIT HYDROGRAPH 63 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   2.04  VOL= 1.00
   102.     302.     570.     893.    1300.    1829.    2436.    3044.    3573.    3946.
  4182.    4294.    4311.    4277.    4076.    3848.    3596.    3314.    2975.    2575.
  2210.    1906.    1671.    1467.    1291.    1145.    1021.     898.     795.     694.
   606.     538.     471.     418.     367.     320.     283.     246.     218.     192.
```

PLATE D-6

	168.	150.	131.	116.	102.	89.	79.	69.	61.	54.
	47.	43.	39.	35.	31.	27.	23.	19.	16.	13.
	9.	6.	2.							

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	0.	1.02	.10	145	.03	.02	.00	327.
1.01	.20	2	.00	0.00	.00	0.	1.02	.20	146	.03	.02	.00	323.
1.01	.30	3	.00	0.00	.00	0.	1.02	.30	147	.03	.02	.00	327.
1.01	.40	4	.00	0.00	.00	0.	1.02	.40	148	.03	.02	.00	337.
1.01	.50	5	.00	0.00	.00	0.	1.02	.50	149	.03	.02	.00	358.
1.01	1.00	6	.00	0.00	.00	0.	1.02	1.00	150	.03	.02	.00	390.
1.01	1.10	7	.00	0.00	.00	0.	1.02	1.10	151	.03	.02	.00	436.
1.01	1.20	8	.00	0.00	.00	0.	1.02	1.20	152	.03	.02	.00	496.
1.01	1.30	9	.00	0.00	.00	0.	1.02	1.30	153	.03	.02	.00	567.
1.01	1.40	10	.00	0.00	.00	0.	1.02	1.40	154	.03	.02	.00	646.
1.01	1.50	11	.00	0.00	.00	0.	1.02	1.50	155	.03	.02	.00	732.
1.01	2.00	12	.00	0.00	.00	0.	1.02	2.00	156	.03	.02	.00	820.
1.01	2.10	13	.00	0.00	.00	0.	1.02	2.10	157	.03	.02	.00	909.
1.01	2.20	14	.00	0.00	.00	0.	1.02	2.20	158	.03	.02	.00	999.
1.01	2.30	15	.00	0.00	.00	0.	1.02	2.30	159	.03	.02	.00	1084.
1.01	2.40	16	.00	0.00	.00	0.	1.02	2.40	160	.03	.02	.00	1166.
1.01	2.50	17	.00	0.00	.00	0.	1.02	2.50	161	.03	.02	.00	1242.
1.01	3.00	18	.00	0.00	.00	0.	1.02	3.00	162	.03	.02	.00	1312.
1.01	3.10	19	.00	0.00	.00	0.	1.02	3.10	163	.03	.02	.00	1376.
1.01	3.20	20	.00	0.00	.00	0.	1.02	3.20	164	.03	.02	.00	1431.
1.01	3.30	21	.00	0.00	.00	0.	1.02	3.30	165	.03	.03	.00	1479.
1.01	3.40	22	.00	0.00	.00	0.	1.02	3.40	166	.03	.03	.00	1520.
1.01	3.50	23	.00	0.00	.00	0.	1.02	3.50	167	.03	.03	.00	1557.
1.01	4.00	24	.00	0.00	.00	0.	1.02	4.00	168	.03	.03	.00	1589.
1.01	4.10	25	.00	0.00	.00	0.	1.02	4.10	169	.03	.03	.00	1618.
1.01	4.20	26	.00	0.00	.00	0.	1.02	4.20	170	.03	.03	.00	1644.
1.01	4.30	27	.00	0.00	.00	0.	1.02	4.30	171	.03	.03	.00	1667.
1.01	4.40	28	.00	0.00	.00	0.	1.02	4.40	172	.03	.03	.00	1688.
1.01	4.50	29	.00	0.00	.00	0.	1.02	4.50	173	.03	.03	.00	1706.
1.01	5.00	30	.00	0.00	.00	0.	1.02	5.00	174	.03	.03	.00	1723.
1.01	5.10	31	.00	0.00	.00	0.	1.02	5.10	175	.03	.03	.00	1737.
1.01	5.20	32	.00	0.00	.00	0.	1.02	5.20	176	.03	.03	.00	1750.
1.01	5.30	33	.00	0.00	.00	0.	1.02	5.30	177	.03	.03	.00	1762.
1.01	5.40	34	.00	0.00	.00	0.	1.02	5.40	178	.03	.03	.00	1772.
1.01	5.50	35	.00	0.00	.00	0.	1.02	5.50	179	.03	.03	.00	1782.
1.01	6.00	36	.00	0.00	.00	0.	1.02	6.00	180	.03	.03	.00	1790.
1.01	6.10	37	.01	0.00	.01	0.	1.02	6.10	181	.12	.11	.01	1807.
1.01	6.20	38	.01	0.00	.01	0.	1.02	6.20	182	.12	.11	.01	1840.
1.01	6.30	39	.01	0.00	.01	0.	1.02	6.30	183	.12	.11	.01	1897.
1.01	6.40	40	.01	0.00	.01	0.	1.02	6.40	184	.12	.11	.01	1982.
1.01	6.50	41	.01	0.00	.01	0.	1.02	6.50	185	.12	.12	.00	2103.
1.01	7.00	42	.01	0.00	.01	0.	1.02	7.00	186	.12	.12	.00	2271.
1.01	7.10	43	.01	0.00	.01	0.	1.02	7.10	187	.12	.12	.00	2493.
1.01	7.20	44	.01	0.00	.01	0.	1.02	7.20	188	.12	.12	.00	2769.
1.01	7.30	45	.01	0.00	.01	0.	1.02	7.30	189	.12	.12	.00	3092.
1.01	7.40	46	.01	0.00	.01	0.	1.02	7.40	190	.12	.12	.00	3449.
1.01	7.50	47	.01	.00	.01	0.	1.02	7.50	191	.12	.12	.00	3827.
1.01	8.00	48	.01	.00	.01	0.	1.02	8.00	192	.12	.12	.00	4217.
1.01	8.10	49	.01	.00	.01	0.	1.02	8.10	193	.12	.12	.00	4608.
1.01	8.20	50	.01	.00	.01	0.	1.02	8.20	194	.12	.12	.00	4997.
1.01	8.30	51	.01	.00	.01	1.	1.02	8.30	195	.12	.12	.00	5368.
1.01	8.40	52	.01	.00	.01	2.	1.02	8.40	196	.12	.12	.00	5720.
1.01	8.50	53	.01	.00	.01	3.	1.02	8.50	197	.12	.12	.00	6050.
1.01	9.00	54	.01	.00	.01	4.	1.02	9.00	198	.12	.12	.00	6356.
1.01	9.10	55	.01	.00	.01	7.	1.02	9.10	199	.12	.12	.00	6631.

1.01	9.20	56	.01	.00	.01	10.	1.02	9.20	200	.12	.12	.00	6871.
1.01	9.30	57	.01	.00	.01	14.	1.02	9.30	201	.12	.12	.00	7078.
1.01	9.40	58	.01	.00	.01	18.	1.02	9.40	202	.12	.12	.00	7259.
1.01	9.50	59	.01	.00	.01	24.	1.02	9.50	203	.12	.12	.00	7418.
1.01	10.00	60	.01	.00	.01	30.	1.02	10.00	204	.12	.12	.00	7559.
1.01	10.10	61	.01	.00	.01	38.	1.02	10.10	205	.12	.12	.00	7684.
1.01	10.20	62	.01	.00	.01	45.	1.02	10.20	206	.12	.12	.00	7796.
1.01	10.30	63	.01	.00	.01	54.	1.02	10.30	207	.12	.12	.00	7896.
1.01	10.40	64	.01	.00	.01	63.	1.02	10.40	208	.12	.12	.00	7985.
1.01	10.50	65	.01	.00	.01	73.	1.02	10.50	209	.12	.12	.00	8065.
1.01	11.00	66	.01	.00	.01	82.	1.02	11.00	210	.12	.12	.00	8135.
1.01	11.10	67	.01	.00	.01	93.	1.02	11.10	211	.12	.12	.00	8198.
1.01	11.20	68	.01	.00	.01	103.	1.02	11.20	212	.12	.12	.00	8254.
1.01	11.30	69	.01	.00	.01	114.	1.02	11.30	213	.12	.12	.00	8303.
1.01	11.40	70	.01	.00	.01	124.	1.02	11.40	214	.12	.12	.00	8348.
1.01	11.50	71	.01	.00	.01	135.	1.02	11.50	215	.12	.12	.00	8388.
1.01	12.00	72	.01	.00	.01	146.	1.02	12.00	216	.12	.12	.00	8423.
1.01	12.10	73	.03	.01	.02	157.	1.02	12.10	217	.38	.38	.00	8481.
1.01	12.20	74	.03	.01	.02	171.	1.02	12.20	218	.38	.38	.00	8587.
1.01	12.30	75	.03	.02	.02	187.	1.02	12.30	219	.38	.38	.00	8759.
1.01	12.40	76	.03	.02	.02	206.	1.02	12.40	220	.38	.38	.00	9011.
1.01	12.50	77	.03	.02	.02	231.	1.02	12.50	221	.38	.38	.00	9366.
1.01	13.00	78	.03	.02	.02	261.	1.02	13.00	222	.38	.38	.00	9856.
1.01	13.10	79	.04	.02	.02	298.	1.02	13.10	223	.46	.45	.00	10508.
1.01	13.20	80	.04	.02	.02	344.	1.02	13.20	224	.46	.45	.00	11329.
1.01	13.30	81	.04	.02	.02	398.	1.02	13.30	225	.46	.45	.00	12307.
1.01	13.40	82	.04	.03	.02	460.	1.02	13.40	226	.46	.45	.00	13404.
1.01	13.50	83	.04	.03	.01	528.	1.02	13.50	227	.46	.45	.00	14592.
1.01	14.00	84	.04	.03	.01	603.	1.02	14.00	228	.46	.45	.00	15849.
1.01	14.10	85	.05	.03	.02	683.	1.02	14.10	229	.57	.57	.00	17167.
1.01	14.20	86	.05	.04	.02	770.	1.02	14.20	230	.57	.57	.00	18546.
1.01	14.30	87	.05	.04	.01	862.	1.02	14.30	231	.57	.57	.00	19943.
1.01	14.40	88	.05	.04	.01	958.	1.02	14.40	232	.57	.57	.00	21346.
1.01	14.50	89	.05	.04	.01	1058.	1.02	14.50	233	.57	.57	.00	22749.
1.01	15.00	90	.05	.04	.01	1161.	1.02	15.00	234	.57	.57	.00	24148.
1.01	15.10	91	.05	.04	.01	1267.	1.02	15.10	235	.52	.52	.00	25525.
1.01	15.20	92	.08	.06	.02	1377.	1.02	15.20	236	.87	.86	.00	26891.
1.01	15.30	93	.14	.11	.03	1497.	1.02	15.30	237	1.56	1.56	.00	28333.
1.01	15.40	94	.35	.29	.06	1650.	1.02	15.40	238	3.90	3.89	.01	30175.
1.01	15.50	95	.10	.09	.01	1838.	1.02	15.50	239	1.13	1.12	.00	32426.
1.01	16.00	96	.06	.05	.01	2051.	1.02	16.00	240	.69	.69	.00	34982.
1.01	16.10	97	.05	.04	.01	2289.	1.02	16.10	241	.53	.53	.00	37812.
1.01	16.20	98	.05	.04	.01	2558.	1.02	16.20	242	.53	.53	.00	41024.
1.01	16.30	99	.05	.04	.01	2863.	1.02	16.30	243	.53	.53	.00	44684.
1.01	16.40	100	.05	.04	.01	3189.	1.02	16.40	244	.53	.53	.00	48571.
1.01	16.50	101	.05	.04	.01	3507.	1.02	16.50	245	.53	.53	.00	52315.
1.01	17.00	102	.05	.04	.00	3787.	1.02	17.00	246	.53	.53	.00	55523.
1.01	17.10	103	.04	.03	.00	4007.	1.02	17.10	247	.42	.42	.00	57895.
1.01	17.20	104	.04	.03	.00	4165.	1.02	17.20	248	.42	.42	.00	59448.
1.01	17.30	105	.04	.03	.00	4268.	1.02	17.30	249	.42	.42	.00	60275.
1.01	17.40	106	.04	.03	.00	4325.	1.02	17.40	250	.42	.42	.00	60490.
1.01	17.50	107	.04	.03	.00	4342.	1.02	17.50	251	.42	.42	.00	60194.
1.01	18.00	108	.04	.03	.00	4302.	1.02	18.00	252	.42	.42	.00	59164.
1.01	18.10	109	.00	.00	.00	4232.	1.02	18.10	253	.04	.04	.00	57771.
1.01	18.20	110	.00	.00	.00	4134.	1.02	18.20	254	.04	.04	.00	56041.
1.01	18.30	111	.00	.00	.00	4005.	1.02	18.30	255	.04	.04	.00	53939.
1.01	18.40	112	.00	.00	.00	3839.	1.02	18.40	256	.04	.04	.00	51394.
1.01	18.50	113	.00	.00	.00	3640.	1.02	18.50	257	.04	.04	.00	48470.
1.01	19.00	114	.00	.00	.00	3433.	1.02	19.00	258	.04	.04	.00	45475.
1.01	19.10	115	.00	.00	.00	3225.	1.02	19.10	259	.04	.04	.00	42534.
1.01	19.20	116	.00	.00	.00	3019.	1.02	19.20	260	.04	.04	.00	39673.
1.01	19.30	117	.00	.00	.00	2811.	1.02	19.30	261	.04	.04	.00	36821.

PLATE D-8

1.01	19.40	118	.00	.00	.00	2604.	1.02	19.40	262	.04	.04	.00	34006.
1.01	19.50	119	.00	.00	.00	2400.	1.02	19.50	263	.04	.04	.00	31271.
1.01	20.00	120	.00	.00	.00	2202.	1.02	20.00	264	.04	.04	.00	28623.
1.01	20.10	121	.00	.00	.00	2007.	1.02	20.10	265	.04	.04	.00	26043.
1.01	20.20	122	.00	.00	.00	1822.	1.02	20.20	266	.04	.04	.00	23597.
1.01	20.30	123	.00	.00	.00	1647.	1.02	20.30	267	.04	.04	.00	21301.
1.01	20.40	124	.00	.00	.00	1486.	1.02	20.40	268	.04	.04	.00	19195.
1.01	20.50	125	.00	.00	.00	1340.	1.02	20.50	269	.04	.04	.00	17287.
1.01	21.00	126	.00	.00	.00	1206.	1.02	21.00	270	.04	.04	.00	15536.
1.01	21.10	127	.00	.00	.00	1087.	1.02	21.10	271	.04	.04	.00	13987.
1.01	21.20	128	.00	.00	.00	983.	1.02	21.20	272	.04	.04	.00	12627.
1.01	21.30	129	.00	.00	.00	892.	1.02	21.30	273	.04	.04	.00	11445.
1.01	21.40	130	.00	.00	.00	814.	1.02	21.40	274	.04	.04	.00	10427.
1.01	21.50	131	.00	.00	.00	745.	1.02	21.50	275	.04	.04	.00	9524.
1.01	22.00	132	.00	.00	.00	685.	1.02	22.00	276	.04	.04	.00	8763.
1.01	22.10	133	.00	.00	.00	633.	1.02	22.10	277	.04	.04	.00	8055.
1.01	22.20	134	.00	.00	.00	586.	1.02	22.20	278	.04	.04	.00	7442.
1.01	22.30	135	.00	.00	.00	544.	1.02	22.30	279	.04	.04	.00	6902.
1.01	22.40	136	.00	.00	.00	508.	1.02	22.40	280	.04	.04	.00	6422.
1.01	22.50	137	.00	.00	.00	475.	1.02	22.50	281	.04	.04	.00	5999.
1.01	23.00	138	.00	.00	.00	447.	1.02	23.00	282	.04	.04	.00	5629.
1.01	23.10	139	.00	.00	.00	422.	1.02	23.10	283	.04	.04	.00	5302.
1.01	23.20	140	.00	.00	.00	400.	1.02	23.20	284	.04	.04	.00	5015.
1.01	23.30	141	.00	.00	.00	381.	1.02	23.30	285	.04	.04	.00	4761.
1.01	23.40	142	.00	.00	.00	364.	1.02	23.40	286	.04	.04	.00	4538.
1.01	23.50	143	.00	.00	.00	349.	1.02	23.50	287	.04	.04	.00	4343.
1.02	0.00	144	.00	.00	.00	336.	1.03	0.00	288	.04	.04	.00	4172.
									SUM	32.16	31.00	1.16	2226688.
										(817.)(787.)(29.)(63052.78)			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	60490.	41118.	14592.	7724.	2224597.
CMS	1713.	1164.	413.	219.	62994.
INCHES		20.13	28.58	30.25	30.25
MM		511.33	725.85	768.46	768.46
AC-FT		20389.	28943.	30642.	30642.
THOUS CU M		25150.	35701.	37796.	37796.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18147.	12335.	4378.	2317.	667379.
CMS	514.	349.	124.	66.	18898.
INCHES		6.04	8.57	9.08	9.08
MM		153.40	217.76	230.54	230.54
AC-FT		6117.	8683.	9193.	9193.
THOUS CU M		7545.	10710.	11339.	11339.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	21172.	14391.	5107.	2704.	778609.
CMS	600.	408.	145.	77.	22048.
INCHES		7.05	10.00	10.59	10.59
MM		178.97	254.05	268.96	268.96
AC-FT		7136.	10130.	10725.	10725.
THOUS CU M		8802.	12495.	13229.	13229.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	60490.	41118.	14592.	7724.	2224597.
CMS	1713.	1164.	413.	219.	62994.
INCHES		20.13	28.58	30.25	30.25
MM		511.33	725.85	768.46	768.46
AC-FT		20389.	28943.	30642.	30642.
THOUS CU M		25150.	35701.	37796.	37796.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RESERVOIR 10384

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-944.	-1

STAGE	944.30	945.00	946.00	948.00	949.50	950.00	952.00	953.00	954.00	955.00
	956.00	957.00	958.00	959.00	960.00	961.00	962.00	963.00	964.00	965.00
FLOW	0.00	27.00	103.00	188.00	230.00	280.00	707.00	849.00	873.00	895.00
	1218.00	2039.00	3361.00	4982.00	6902.00	9072.00	11541.00	14361.00	17379.00	20598.00

CAPACITY=	0.	1293.	4773.	6063.	8593.	9193.	10393.
ELEVATION=	926.	944.	955.	957.	962.	963.	965.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
944.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
962.4	2.9	1.5	1930.

CREST LENGTH AT OR BELOW	0.	220.	590.	805.	1415.	1935.	1935.	1945.	1950.	1960.
ELEVATION	962.4	962.5	962.7	962.9	963.1	963.4	964.0	965.0	966.0	967.0

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PLATE D-10

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*OVN*

                              STATION 000002, PLAN 1, RATIO 2  0.35 PMF

                                   END-OF-PERIOD HYDROGRAPH ORDINATES

                                              OUTFLOW
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
      1.         1.         1.         1.         1.         1.         1.         1.         1.         2.
      2.         2.         2.         3.         3.         3.         4.         4.         5.         5.
      6.         7.         8.         8.         9.        11.        12.        13.        15.        16.
     18.        20.        22.        24.        27.        31.        36.        40.        45.        49.
     53.        58.        62.        65.        69.        72.        75.        78.        80.        82.
     84.        86.        88.        89.        90.        92.        93.        93.        94.        95.
     95.        96.        96.        97.        97.        97.        97.        98.        98.        98.
     98.        98.        98.        98.        98.        98.        98.        99.        99.        99.
     99.        99.        99.       100.       100.       101.       101.       102.       103.       103.
    104.       105.       105.       106.       107.       107.       108.       109.       110.       110.
    111.       112.       113.       114.       115.       115.       116.       117.       118.       119.
    120.       121.       122.       123.       124.       125.       126.       128.       129.       131.
    133.       135.       138.       140.       143.       146.       150.       153.       157.       161.
    165.       169.       173.       177.       182.       186.       190.       193.       196.       199.
    202.       205.       208.       211.       214.       217.       221.       224.       227.       231.
    243.       256.       270.       289.       323.       359.       399.       442.       489.       539.
    593.       651.       711.       755.       801.       849.       858.       867.       877.       887.
    894.       994.      1114.      1286.      1641.      2014.      2592.      3164.      3813.      4488.
   5163.      5886.      6556.      7204.      7827.      8377.      8848.      9264.      9624.      9904.
  10108.     10242.     10310.     10320.     10277.     10183.     10047.      9873.      9668.      9438.
   9187.      8939.      8694.      8442.      8186.      7928.      7669.      7413.      7159.      6909.
   6690.      6476.      6267.      6062.      5862.      5667.      5478.      5295.

                                              STORAGE
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.      1293.
   1294.      1294.      1294.      1294.      1295.      1295.      1295.      1296.      1296.      1297.
   1298.      1298.      1299.      1300.      1301.      1302.      1303.      1304.      1305.      1307.
   1308.      1310.      1313.      1316.      1319.      1322.      1326.      1330.      1335.      1340.
   1346.      1352.      1359.      1367.      1375.      1384.      1395.      1406.      1419.      1433.
   1449.      1467.      1485.      1504.      1524.      1545.      1565.      1585.      1605.      1625.
   1644.      1662.      1679.      1695.      1710.      1725.      1738.      1750.      1761.      1771.
   1780.      1788.      1795.      1801.      1807.      1812.      1816.      1820.      1823.      1826.
   1828.      1830.      1832.      1834.      1835.      1836.      1837.      1838.      1839.      1840.
   1840.      1840.      1841.      1841.      1841.      1842.      1842.      1842.      1842.      1843.
   1843.      1844.      1846.      1847.      1849.      1851.      1854.      1857.      1861.      1865.
   1869.      1874.      1879.      1884.      1890.      1896.      1902.      1908.      1914.      1920.
   1927.      1933.      1940.      1947.      1953.      1960.      1967.      1974.      1981.      1988.
   1995.      2002.      2009.      2017.      2025.      2034.      2044.      2055.      2067.      2081.
   2097.      2114.      2134.      2155.      2178.      2203.      2229.      2257.      2286.      2316.
   2348.      2380.      2413.      2447.      2481.      2516.      2551.      2587.      2623.      2659.
   2696.      2733.      2770.      2807.      2844.      2882.      2920.      2958.      2996.      3036.
   3077.      3120.      3165.      3214.      3267.      3324.      3387.      3454.      3527.      3606.
   3691.      3782.      3879.      3982.      4091.      4206.      4327.      4457.      4596.      4746.
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    4909.     5086.     5278.     5486.     5709.     5944.     6186.     6429.     6670.     6904.
    7128.     7340.     7536.     7715.     7877.     8019.     8141.     8243.     8325.     8389.
    8435.     8466.     8481.     8484.     8474.     8453.     8421.     8382.     8335.     8283.
    8226.     8165.     8102.     8036.     7970.     7903.     7836.     7770.     7704.     7639.
    7575.     7513.     7451.     7391.     7333.     7276.     7220.     7167.

                                          STAGE
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
    944.3     944.4     944.4     944.4     944.4     944.4     944.4     944.4     944.4     944.4
    944.5     944.5     944.5     944.5     944.5     944.6     944.6     944.6     944.7     944.7
    944.8     944.8     944.9     944.9     945.0     945.1     945.1     945.2     945.2     945.3
    945.3     945.4     945.5     945.5     945.5     945.6     945.6     945.7     945.7     945.7
    945.8     945.8     945.8     945.8     945.8     945.8     945.9     945.9     945.9     945.9
    945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9
    945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9     945.9
    945.9     945.9     946.0     946.0     946.0     946.0     946.0     946.0     946.0     946.0
    946.0     946.0     946.1     946.1     946.1     946.1     946.1     946.1     946.2     946.2
    946.2     946.2     946.2     946.3     946.3     946.3     946.3     946.3     946.4     946.4
    946.4     946.4     946.4     946.5     946.5     946.5     946.5     946.6     946.6     946.7
    946.7     946.8     946.8     946.9     946.9     947.0     947.1     947.2     947.3     947.4
    947.5     947.5     947.6     947.7     947.9     948.0     948.1     948.2     948.3     948.4
    948.5     948.6     948.7     948.8     948.9     949.0     949.2     949.3     949.4     949.5
    949.6     949.8     949.9     950.0     950.2     950.4     950.6     950.8     951.0     951.2
    951.5     951.7     952.0     952.3     952.7     953.0     953.4     953.8     954.2     954.6
    955.0     955.3     955.7     956.1     956.5     957.0     957.4     957.9     958.3     958.7
    959.1     959.5     959.8     960.1     960.4     960.7     960.9     961.1     961.2     961.3
    961.4     961.5     961.5     961.5     961.5     961.5     961.4     961.3     961.2     961.1
    961.0     960.9     960.8     960.7     960.6     960.5     960.4     960.2     960.1     960.0
    959.9     959.8     959.7     959.6     959.5     959.4     959.3     959.2

PEAK OUTFLOW IS    10320. AT TIME  44.00 HOURS

                            PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME
                  CFS     10320.     8245.      2422.      1223.         352179.
                  CMS       292.      233.        69.        35.           9973.
               INCHES                 4.04       4.74       4.79            4.79
                   MM               102.53     120.49     121.66          121.66
                AC-FT                4088.      4805.      4851.           4851.
           THOUS CU M                5043.      5926.      5984.           5984.
```

DVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0. 4000. 8000. 12000. 16000. 20000. 24000. 0. 0. 0. 0. 0. 0.

.10 11
.20 21
.30 31
.40 41
.50 51
1.00 61
1.10 71
1.20 81
1.30 91
1.40 101
1.50 111
2.00 121
2.10 131
2.20 141
2.30 151
2.40 161
2.50 171
3.00 181
3.10 191
3.20 201
3.30 211
3.40 221
3.50 231
4.00 241
4.10 251
4.20 261
4.30 271
4.40 281
4.50 291
5.00 301
5.10 311
5.20 321
5.30 331
5.40 341
5.50 351
6.00 361
6.10 371
6.20 381
6.30 391
6.40 401
6.50 411
7.00 421
7.10 431
7.20 441
7.30 451
7.40 461
7.50 471
8.00 481
8.10 491
8.20 501
8.30 511
8.40 521
8.50 531
9.00 541
9.10 551
9.20 561

PLATE D-13


9.30 57
9.40 58
9.50 59
10.00 60
10.10 61
10.20 62
10.30 63
10.40 64
10.50 65
11.00 66
11.10 67
11.20 68
11.30 69
11.40 70
11.50 71
12.00 72
12.10 73
12.20 74
12.30 75
12.40 76
12.50 77
13.00 78
13.10 79
13.20 80
13.30 81
13.40 82
13.50 83
14.00 84
14.10 85
14.20 86
14.30 87
14.40 88
14.50 89
15.00 900
15.10 910
15.20 920
15.30 930
15.40 940
15.50 950
16.00 960
16.10 970
16.20 980
16.30 990
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17.101030
17.201040
17.301050
17.401060
17.501070
18.001080
18.101090
18.201100
18.301110
18.401120
18.501130
19.001140
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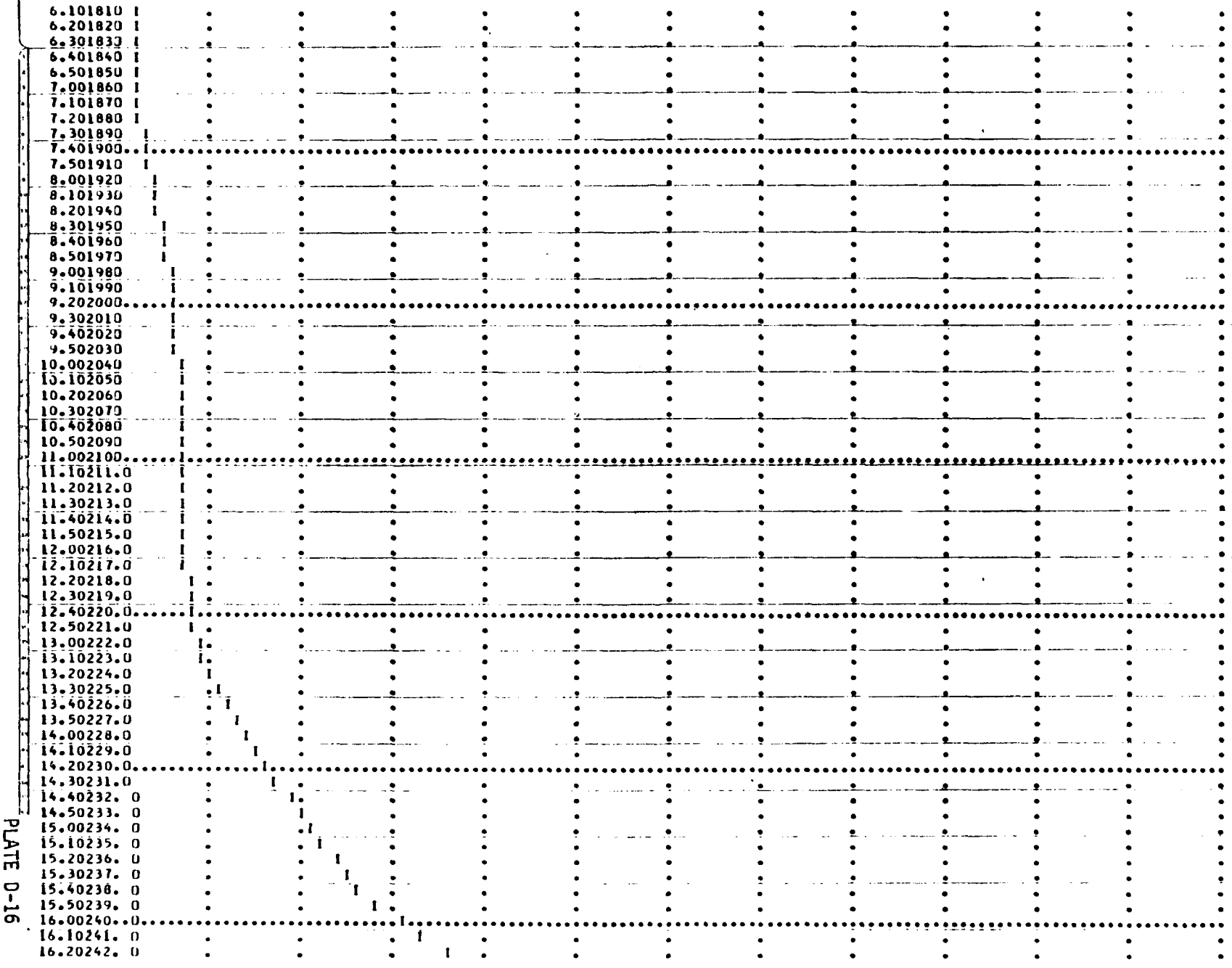
19.301170
19.401180

PLATE D-14

PLATE D-15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7.201880
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7.401900
7.501910
8.001920
8.101930
8.201940
8.301950
8.401960
8.501970
9.001980
9.101990
9.202000
9.302010
9.402020
9.502030
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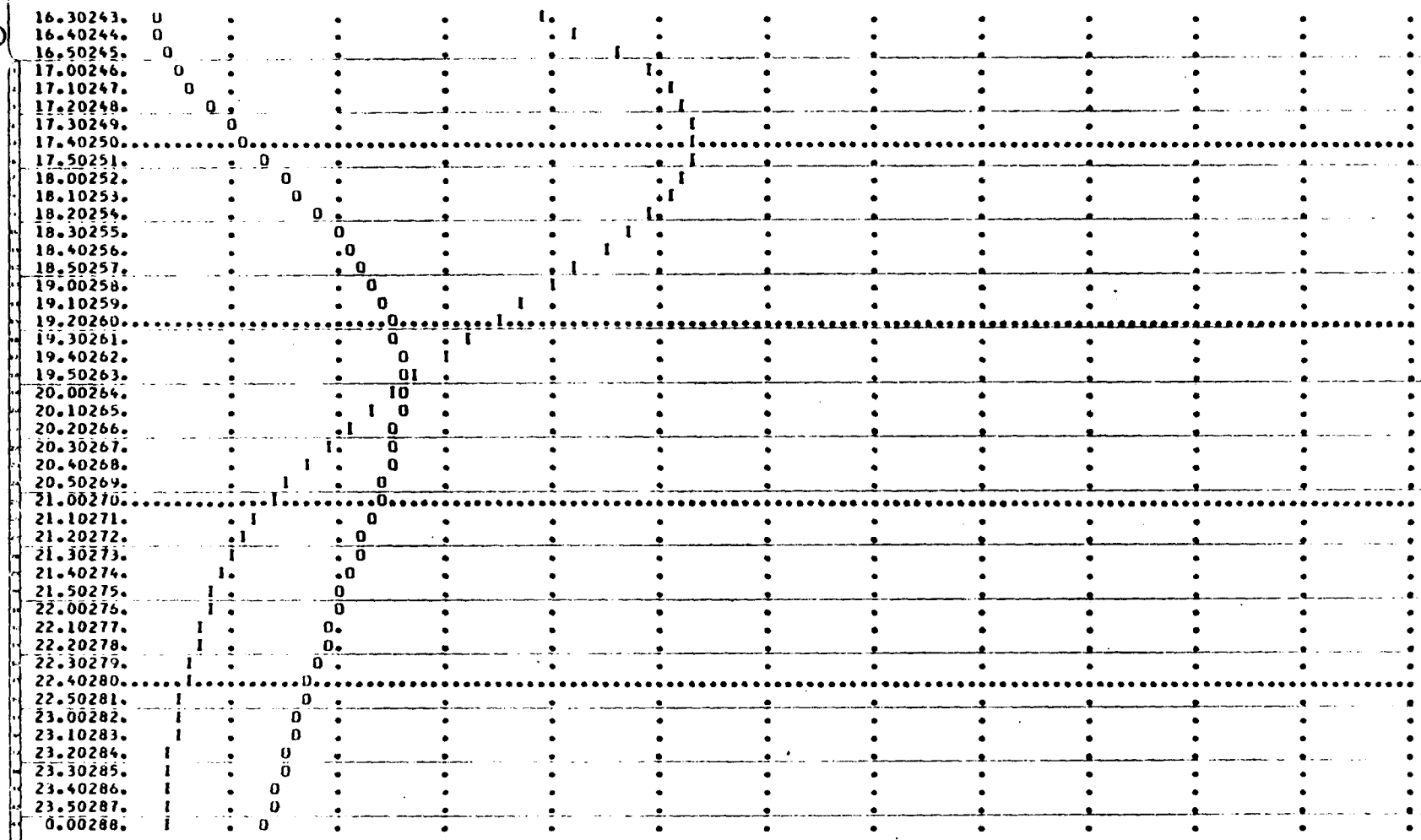
PLATE D-16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19.20260.
19.30261.
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22.10277.
22.20278.
22.30279.
22.40280.
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23.30285.
23.40286.
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0.00288.

PLATE D-17

DVN

STATION 000002, PLAN 1, RATIO 5 [0.50 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
3.	3.	3.	4.	4.	5.	5.	6.	7.	8.
9.	10.	11.	12.	13.	15.	17.	19.	21.	23.
26.	30.	36.	42.	49.	55.	62.	69.	75.	81.
87.	93.	99.	104.	106.	109.	111.	113.	115.	117.
119.	120.	122.	123.	124.	125.	125.	126.	127.	127.
128.	128.	128.	129.	129.	129.	129.	130.	130.	130.
130.	130.	130.	130.	130.	130.	130.	131.	131.	131.
131.	131.	131.	132.	132.	132.	133.	133.	134.	135.
136.	137.	138.	139.	140.	141.	142.	143.	144.	145.
146.	148.	149.	150.	151.	153.	154.	155.	156.	158.
159.	160.	162.	163.	165.	166.	168.	170.	172.	175.
178.	181.	184.	188.	191.	194.	197.	200.	204.	208.
211.	215.	219.	223.	227.	236.	251.	266.	283.	316.
349.	382.	415.	448.	481.	513.	546.	578.	611.	645.
679.	713.	738.	766.	796.	828.	852.	858.	866.	873.
881.	889.	900.	993.	1091.	1194.	1432.	1718.	2020.	2505.
3005.	3577.	4272.	5019.	5947.	6915.	8025.	9136.	10357.	11691.
13219.	15210.	17334.	19480.	21217.	22391.	23000.	23116.	22850.	22309.
21575.	20708.	19761.	18777.	17795.	16854.	15972.	15178.	14365.	13636.
13026.	12499.	11975.	11461.	11001.	10588.	10213.	9841.	9474.	9113.
8797.	8492.	8194.	7903.	7620.	7346.	7081.	6833.		

STORAGE

1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
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1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1294.
1294.	1294.	1295.	1295.	1295.	1296.	1297.	1297.	1298.	1299.
1300.	1301.	1302.	1303.	1304.	1305.	1307.	1308.	1310.	1313.
1315.	1318.	1321.	1325.	1330.	1334.	1340.	1346.	1353.	1361.
1369.	1378.	1388.	1398.	1410.	1423.	1438.	1454.	1473.	1493.
1516.	1541.	1567.	1595.	1623.	1652.	1681.	1710.	1738.	1766.
1793.	1819.	1843.	1866.	1888.	1908.	1926.	1943.	1959.	1973.
1986.	1998.	2008.	2017.	2025.	2032.	2038.	2044.	2048.	2053.
2056.	2059.	2062.	2065.	2067.	2068.	2070.	2071.	2073.	2074.
2075.	2075.	2076.	2077.	2077.	2078.	2078.	2078.	2079.	2080.
2081.	2082.	2084.	2087.	2089.	2093.	2097.	2102.	2107.	2113.
2119.	2126.	2134.	2142.	2150.	2158.	2167.	2176.	2185.	2194.
2203.	2213.	2222.	2232.	2242.	2252.	2262.	2272.	2282.	2292.
2302.	2313.	2323.	2335.	2346.	2359.	2373.	2389.	2407.	2427.
2450.	2475.	2503.	2533.	2566.	2602.	2640.	2680.	2722.	2765.
2810.	2857.	2904.	2953.	3002.	3052.	3103.	3154.	3206.	3257.
3309.	3361.	3412.	3464.	3515.	3566.	3617.	3668.	3719.	3772.
3826.	3883.	3943.	4008.	4078.	4156.	4240.	4333.	4435.	4546.
4667.	4797.	4936.	5085.	5241.	5406.	5578.	5758.	5948.	6149.

PLATE D-18

```
     6361.     6588.     6829.     7086.     7358.     7640.     7928.     8214.     8492.     8756.
     9000.     9215.     9394.     9532.     9631.     9693.     9724.     9730.     9717.     9689.
     9650.     9603.     9549.     9490.     9426.     9358.     9287.     9212.     9134.     9054.
     8972.     8888.     8803.     8716.     8630.     8545.     8459.     8375.     8291.     8209.
     8128.     8049.     7972.     7897.     7823.     7752.     7684.     7617.

                                          STAGE
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.4     944.4
     944.4     944.4     944.4     944.4     944.4     944.4     944.4     944.5     944.5     944.5
     944.5     944.6     944.6     944.6     944.6     944.7     944.7     944.8     944.8     944.9
     945.0     945.0     945.1     945.2     945.3     945.4     945.5     945.5     945.6     945.7
     945.8     945.9     945.9     946.0     946.1     946.1     946.2     946.2     946.3     946.3
     946.4     946.4     946.4     946.5     946.5     946.5     946.5     946.5     946.6     946.6
     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.6
     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.6     946.7
     946.7     946.7     946.7     946.7     946.7     946.7     946.7     946.7     946.7     946.8
     946.8     946.8     946.8     946.8     946.9     946.9     946.9     946.9     947.0     947.0
     947.0     947.0     947.1     947.1     947.1     947.2     947.2     947.2     947.3     947.3
     947.3     947.3     947.4     947.4     947.4     947.5     947.5     947.6     947.6     947.7
     947.8     947.8     947.9     948.0     948.1     948.2     948.3     948.4     948.6     948.7
     948.8     949.0     949.1     949.3     949.4     949.6     949.7     949.9     950.0     950.2
     950.3     950.5     950.6     950.8     950.9     951.1     951.2     951.4     951.6     951.7
     951.9     952.0     952.2     952.4     952.6     952.9     953.1     953.4     953.7     954.0
     954.4     954.7     955.0     955.3     955.6     955.9     956.3     956.6     957.0     957.4
     957.7     958.1     958.6     959.0     959.5     960.0     960.5     961.0     961.5     962.1
     962.6     963.0     963.3     963.6     963.7     963.8     963.9     963.9     963.9     963.8
     963.8     963.7     963.6     963.5     963.4     963.3     963.2     963.0     962.9     962.7
     962.5     962.3     962.2     962.0     961.8     961.6     961.5     961.3     961.2     961.0
     960.9     960.7     960.6     960.5     960.3     960.2     960.1     960.0

PEAK OUTFLOW IS    23116. AT TIME  43.00 HOURS

                         PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                CFS    23116.    15014.      4503.      2268.        653198.
                CMS      655.      425.       128.        64.         18497.
             INCHES                7.35       8.82       8.88           8.88
                 MM              186.72     223.99     225.64         225.64
              AC-FT               7445.      8931.      8997.          8997.
          THOUS CU M              9183.     11017.     11098.         11098.
```

OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	4000.	8000.	12000.	16000.	20000.	24000.	28000.	32000.	0.	0.	0.	0.
.10	11												
.20	21												
.30	31												
.40	41												
.50	51												
1.00	61												
1.10	71												
1.20	81												
1.30	91												
1.40	101												
1.50	111												
2.00	121												
2.10	131												
2.20	141												
2.30	151												
2.40	161												
2.50	171												
3.00	181												
3.10	191												
3.20	201												
3.30	211												
3.40	221												
3.50	231												
4.00	241												
4.10	251												
4.20	261												
4.30	271												
4.40	281												
4.50	291												
5.00	301												
5.10	311												
5.20	321												
5.30	331												
5.40	341												
5.50	351												
6.00	361												
6.10	371												
6.20	381												
6.30	391												
6.40	401												
6.50	411												
7.00	421												
7.10	431												
7.20	441												
7.30	451												
7.40	461												
7.50	471												
8.00	481												
8.10	491												
8.20	501												
8.30	511												
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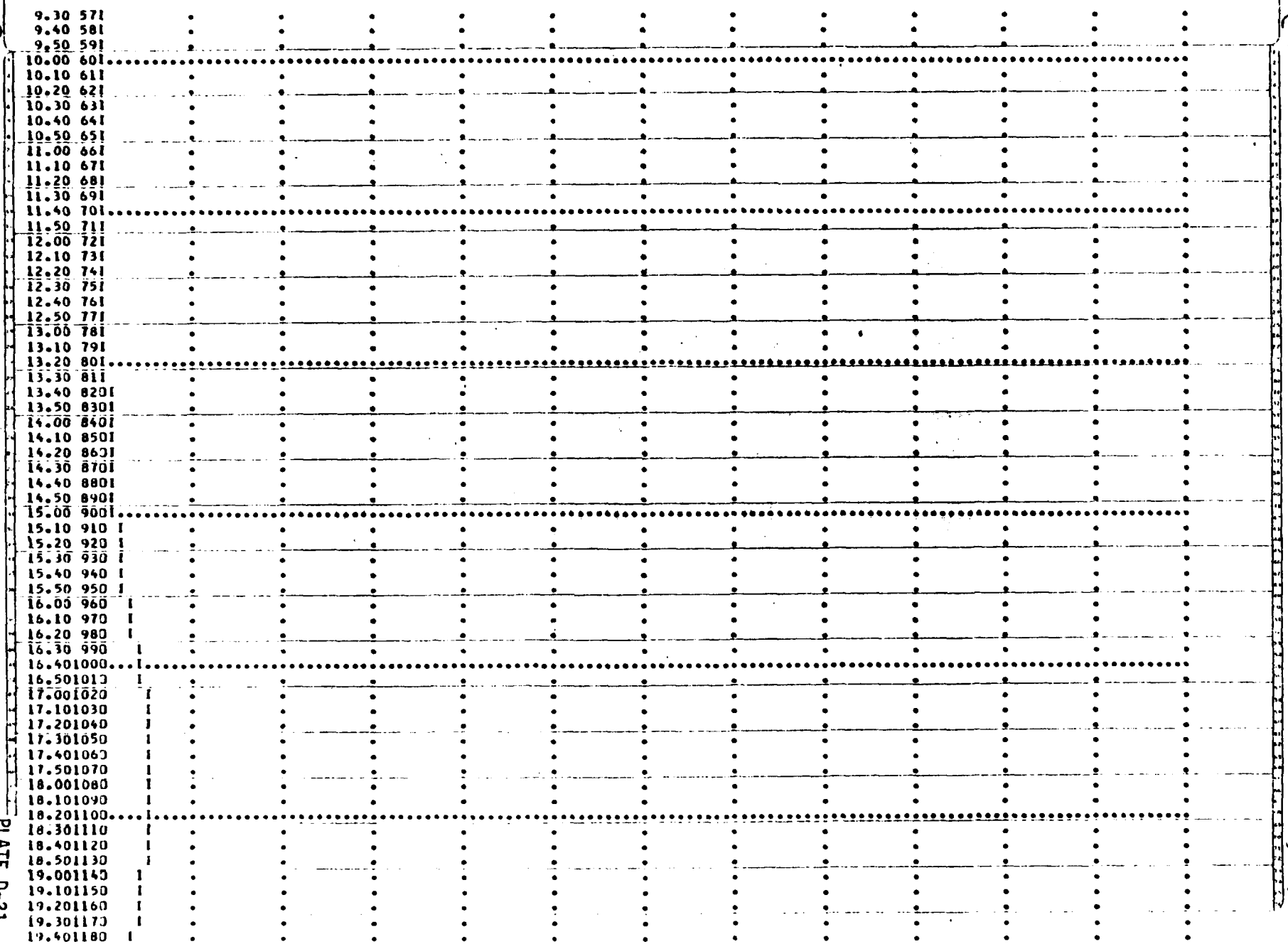
9.20	561												

PLATE D-20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11.20 68
11.30 69
11.40 70
11.50 71
12.00 72
12.10 73
12.20 74
12.30 75
12.40 76
12.50 77
13.00 78
13.10 79
13.20 80
13.30 81
13.40 82
13.50 83
14.00 84
14.10 85
14.20 86
14.30 87
14.40 88
14.50 89
15.00 90
15.10 91
15.20 92
15.30 93
15.40 94
15.50 95
16.00 96
16.10 97
16.20 98
16.30 99
16.40 100
16.50 101
17.00 102
17.10 103
17.20 104
17.30 105
17.40 106
17.50 107
18.00 108
18.10 109
18.20 110
18.30 111
18.40 112
18.50 113
19.00 114
19.10 115
19.20 116
19.30 117
19.40 118

PLATE D-21


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21.501310
22.001320
22.101330
22.201340
22.301350
22.401360
22.501370
23.001380
23.101390
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.301471
.401481
.501491
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1.201520
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2.001560
2.101570
2.201580
2.301590
2.401600
2.501610
3.001620
3.101630
3.201640
3.301650
3.401660
3.501670
4.001680
4.101690
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4.301710
4.401720
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5.501790
6.001800

PLATE D-22

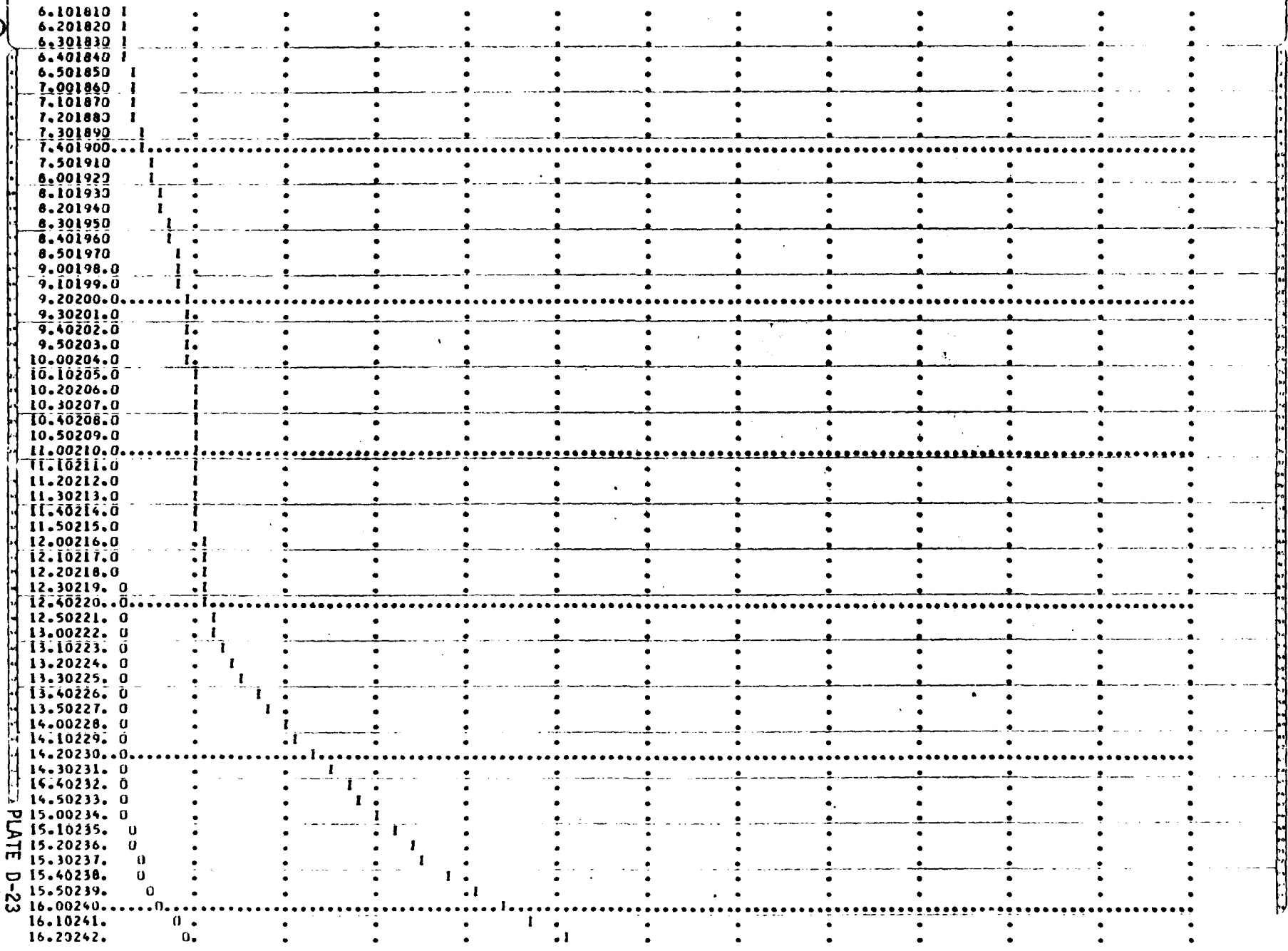
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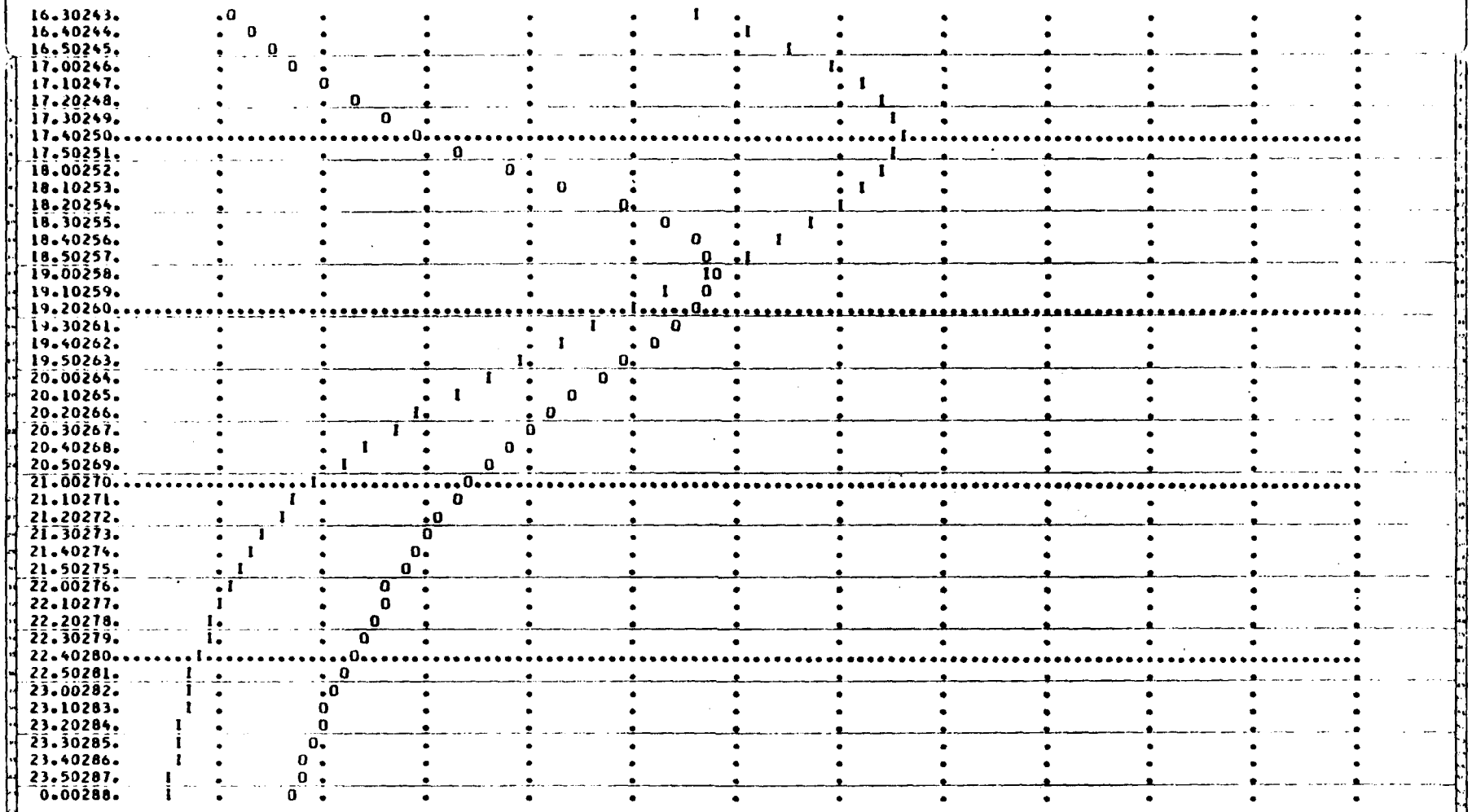
PLATE D-23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0.00288.

PLATE D-24

OVN

STATION 000002, PLAN 1, RATIO 8 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	3.	3.	3.	4.	4.	4.
5.	6.	7.	7.	8.	10.	11.	12.	14.	16.
17.	20.	22.	24.	27.	33.	40.	47.	55.	65.
75.	86.	98.	107.	114.	122.	129.	136.	144.	151.
157.	164.	170.	176.	182.	187.	190.	193.	196.	198.
201.	203.	204.	206.	207.	208.	210.	211.	211.	212.
213.	213.	214.	214.	215.	215.	215.	216.	216.	216.
216.	217.	217.	217.	217.	217.	217.	217.	217.	218.
218.	218.	219.	219.	220.	220.	221.	222.	223.	224.
225.	226.	227.	229.	231.	236.	241.	247.	252.	258.
264.	269.	275.	282.	295.	308.	320.	333.	346.	358.
371.	384.	397.	410.	424.	440.	457.	476.	497.	522.
549.	579.	613.	649.	689.	723.	753.	785.	818.	850.
856.	862.	868.	875.	881.	887.	892.	906.	967.	1028.
1090.	1151.	1212.	1357.	1509.	1659.	1806.	1952.	2133.	2362.
2579.	2803.	3039.	3290.	3606.	3966.	4357.	4780.	5282.	5860.
6475.	7155.	7926.	8730.	9630.	10603.	11802.	13252.	15439.	18449.
22326.	26586.	31055.	35634.	40230.	44669.	48712.	52149.	54866.	56837.
58102.	58674.	58599.	57985.	56905.	55388.	53455.	51189.	48718.	46146.
43532.	40904.	38294.	35729.	33224.	30797.	28471.	26269.	24215.	22340.
20622.	19073.	17711.	16553.	15576.	14720.	13917.	13264.	12730.	12240.
11753.	11306.	10891.	10538.	10207.	9880.	9561.	9250.		

STORAGE

1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
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1293.	1293.	1293.	1293.	1293.	1293.	1293.	1292.	1292.	1292.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.	1293.
1293.	1293.	1293.	1293.	1293.	1293.	1293.	1294.	1294.	1294.
1295.	1295.	1296.	1297.	1298.	1299.	1300.	1301.	1303.	1304.
1306.	1308.	1310.	1312.	1315.	1318.	1321.	1324.	1328.	1332.
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3622.	3669.	3722.	3779.	3841.	3908.	3979.	4054.	4132.	4214.
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6180.	6276.	6376.	6482.	6598.	6723.	6858.	7005.	7163.	7332.
7512.	7703.	7903.	8111.	8327.	8548.	8774.	9005.	9238.	9469.

PLATE D-25

```
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   9598.     9508.     9420.     9335.     9251.     9168.     9087.     9006.     8926.     8846.
   8766.     8687.     8610.     8533.     8458.     8384.     8311.     8240.

                                            STAGE
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   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
   944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3     944.3
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   944.8     944.8     944.9     944.9     945.0     945.1     945.2     945.3     945.4     945.5
   945.6     945.8     945.9     946.1     946.3     946.4     946.6     946.8     947.0     947.1
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PEAK OUTFLOW IS     58674. AT TIME  42.00 HOURS

                             PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                  CFS      58674.    38609.     11888.      5973.       1720300.
                  CMS       1661.     1093.       337.       169.         48713.
               INCHES                 18.90      23.28      23.40          23.40
                   MM                480.13     591.34     594.26         594.26
                AC-FT                19145.     23579.     23696.         23696.
            THOUS CU M               23615.     29085.     29228.         29228.
```

DVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	10000.	20000.	30000.	40000.	50000.	60000.	70000.	0.	0.	0.	0.	0.
.10	11												
.20	21												
.30	31												
.40	41												
.50	51												
1.00	61												
1.10	71												
1.20	81												
1.30	91												
1.40	101												
1.50	111												
2.00	121												
2.10	131												
2.20	141												
2.30	151												
2.40	161												
2.50	171												
3.00	181												
3.10	191												
3.20	201												
3.30	211												
3.40	221												
3.50	231												
4.00	241												
4.10	251												
4.20	261												
4.30	271												
4.40	281												
4.50	291												
5.00	301												
5.10	311												
5.20	321												
5.30	331												
5.40	341												
5.50	351												
6.00	361												
6.10	371												
6.20	381												
6.30	391												
6.40	401												
6.50	411												
7.00	421												
7.10	431												
7.20	441												
7.30	451												
7.40	461												
7.50	471												
8.00	481												
8.10	491												
8.20	501												
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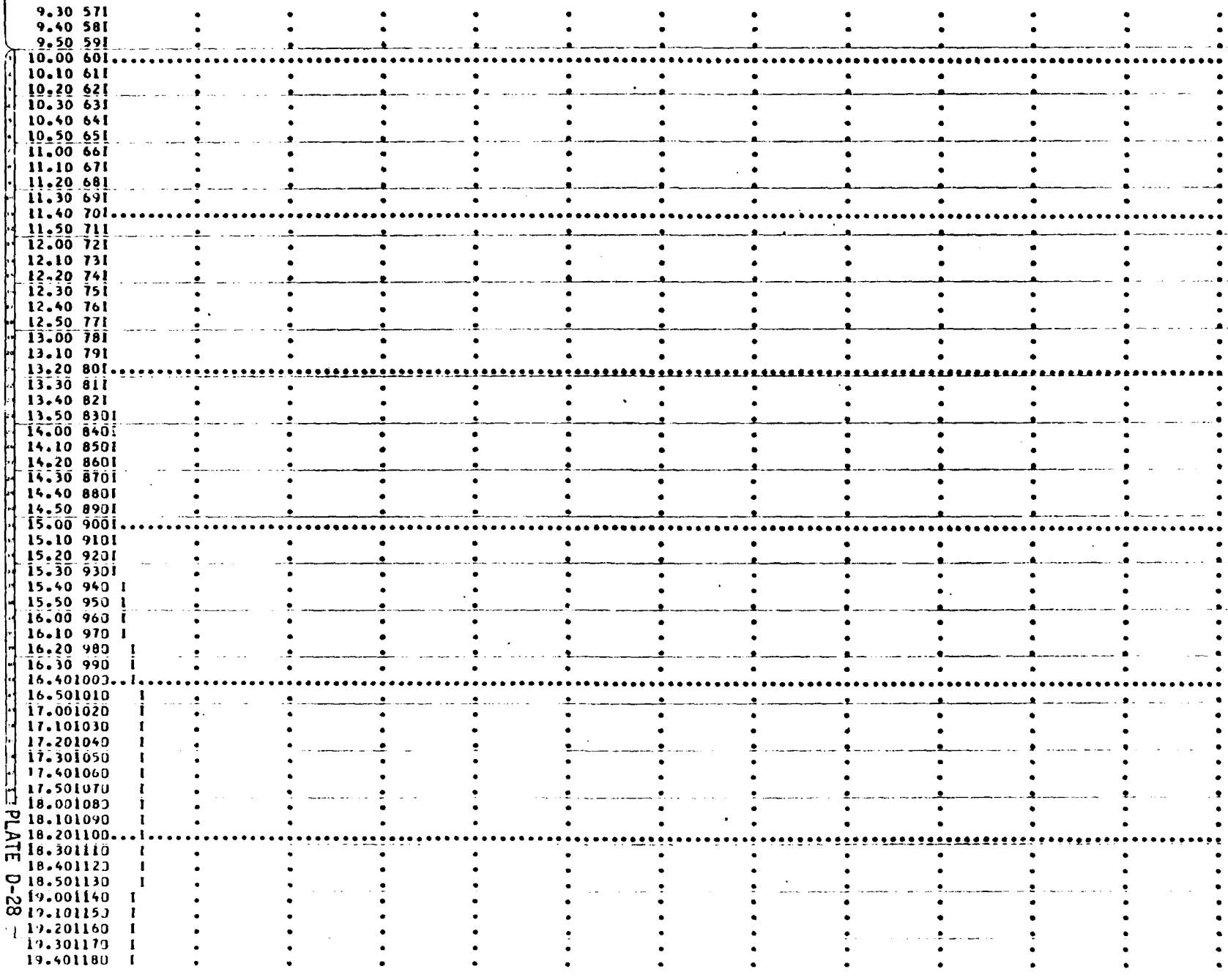
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PLATE D-28

AD-A105 579 HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM, GRINDSTONE-LOST-MUDDY CREEK DAM C---ETC(U)
JUN 80 R S DECKER, G JAMISON, G ULMER DACW43-80-C-0071
UNCLASSIFIED NL

2 OF 2
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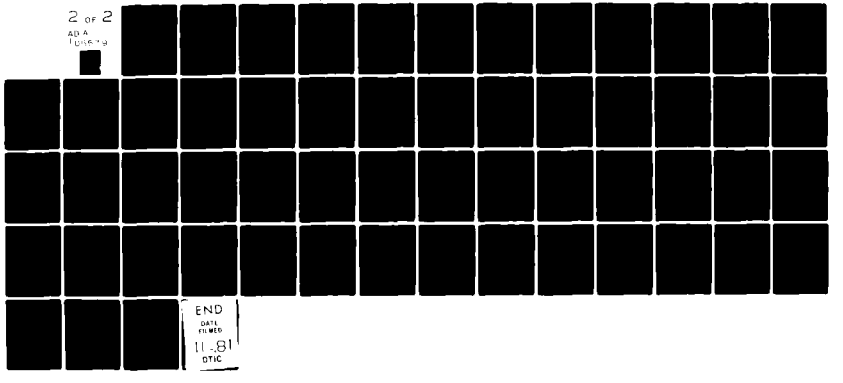

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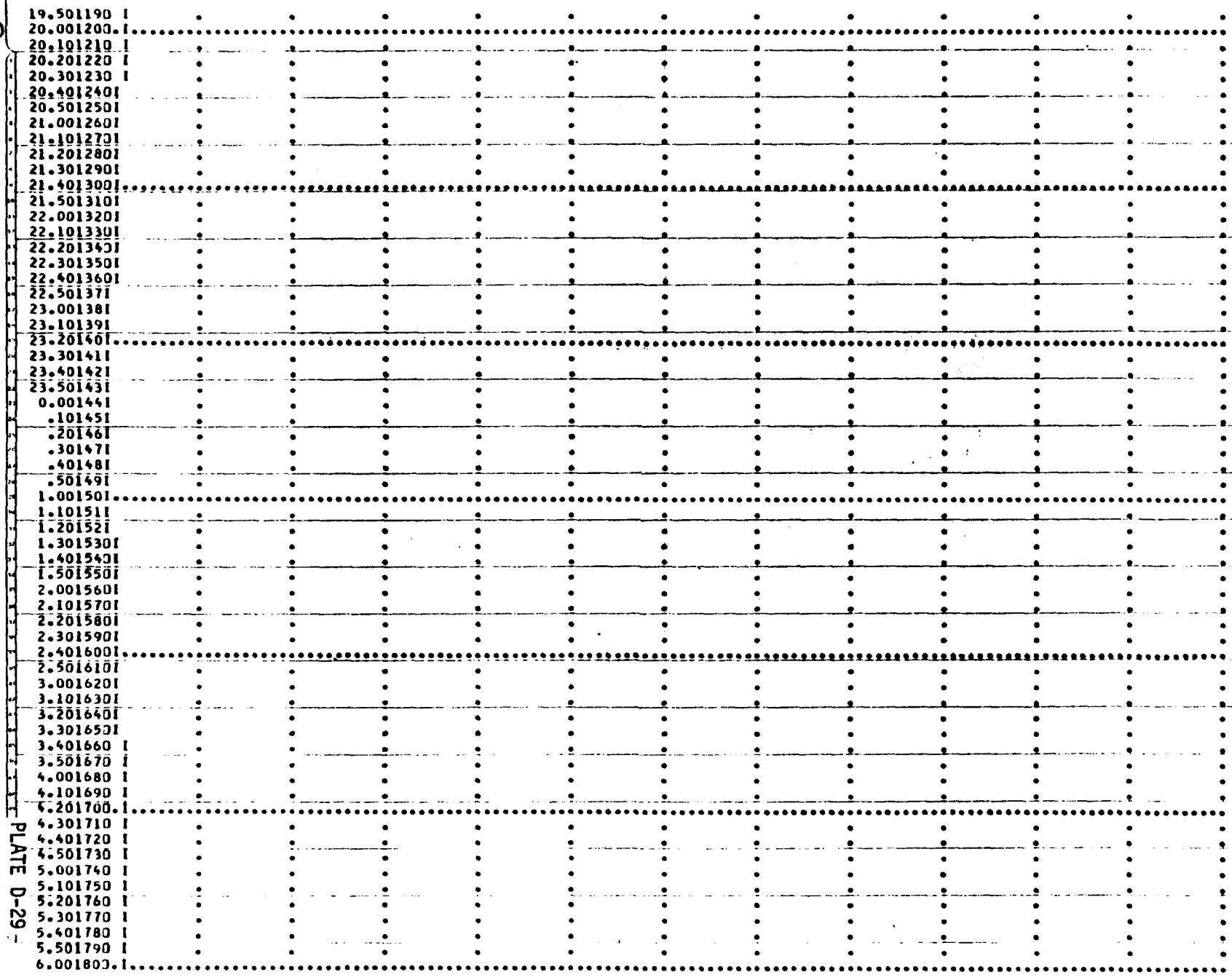
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PLATE D-29

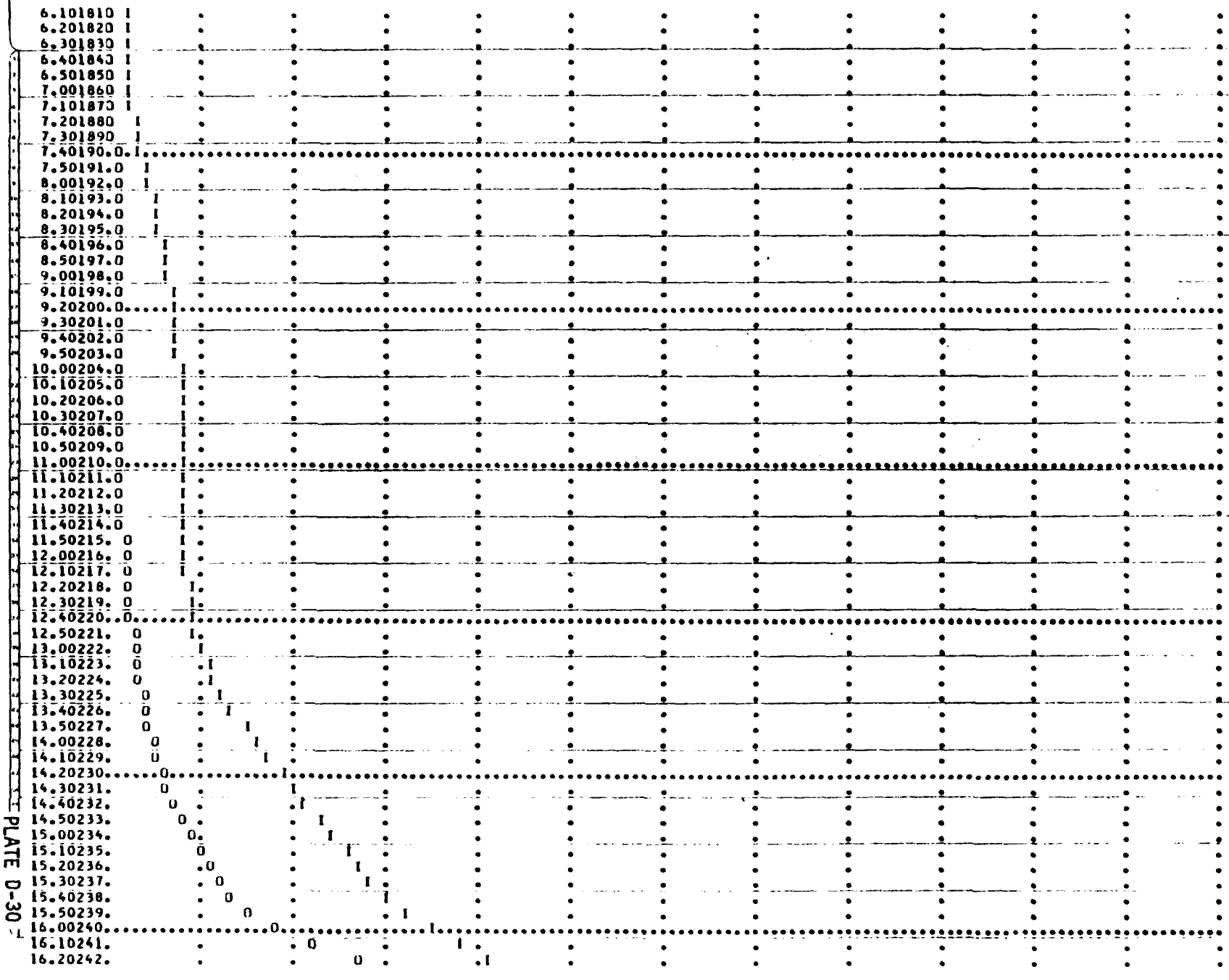
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PLATE D-30

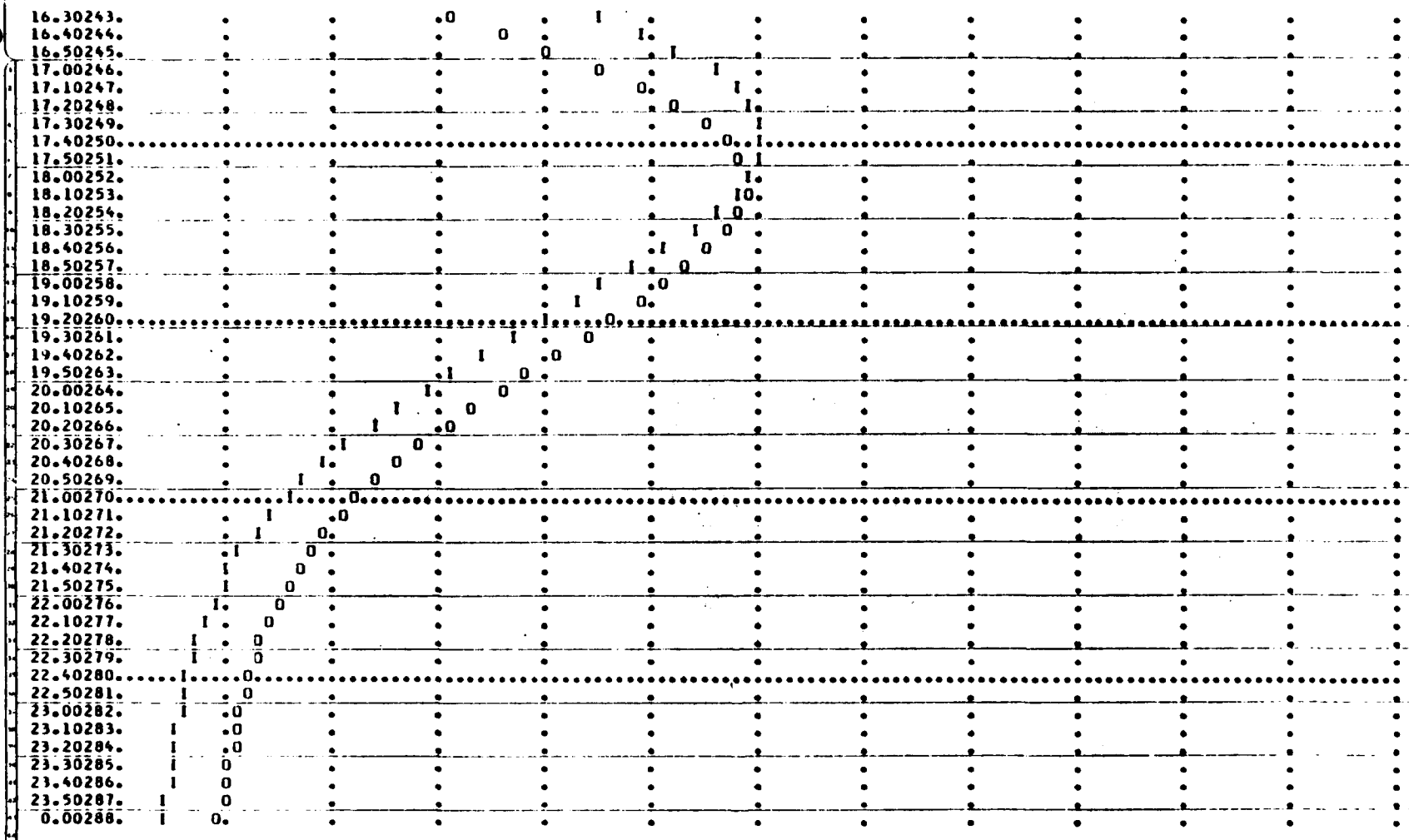
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PLATE D-31

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS							
				RATIO 1 .30	RATIO 2 .35	RATIO 3 .40	RATIO 4 .45	RATIO 5 .50	RATIO 6 .55	RATIO 7 .60	RATIO 8 1.00
HYDROGRAPH AT	000001	19.00	1	18147.	21172.	24196.	27221.	30245.	33270.	36294.	60490.
		(49.21)		(513.87)(	599.51)(	685.16)(	770.80)(	856.44)(	942.09)(	1027.73)(	1712.89)(
ROUTED TO	000002	19.00	1	7634.	10320.	13609.	18204.	23116.	27647.	31810.	58674.
		(49.21)		(216.16)(	292.22)(	385.36)(	515.48)(	654.57)(	782.86)(	900.76)(	1661.45)(

PLATE D-32

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	944.30	944.30	962.40
STORAGE	1293.	1293.	8916.
OUTFLOW	0.	0.	12669.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	960.34	0.00	7827.	7634.	0.00	44.17	0.00
.35	961.51	0.00	8484.	10320.	0.00	44.00	0.00
.40	962.69	.29	9051.	13609.	1.33	43.67	0.00
.45	963.43	1.03	9453.	18204.	2.83	43.33	0.00
.50	963.90	1.50	9730.	23116.	3.50	43.00	0.00
.55	964.25	1.85	9943.	27647.	4.00	42.67	0.00
.60	964.54	2.14	10120.	31810.	4.33	42.50	0.00
1.00	966.11	3.71	11061.	58674.	7.00	42.00	0.00

PLATE D-33

APPENDIX E

GEOLOGICAL INVESTIGATION, SOILS REPORT AND ENGINEERS REPORT

USDA - SCS

1968

APPENDIX E

DIVISION I

DETAILED GEOLOGIC INVESTIGATION
OF DAM SITES

USDA - SCS

APRIL, 1968

Form SCS 376A
Sheet 1 of 12

10-59

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County DeKalb ; ¼, NE ¼, Sec. 13, T 60N R 31W ; Watershed Grindstone-Lost Creek

Subwatershed _____ Fund class WP-08-11-03 (FP-2, WP-1, etc.) Site number C-3 Site group I Structure class b

Investigated by Paul E. Bowles (signature and title) Geologist Equipment used Failing 1500 (Type, size, make, model, etc.) Date 4-24-68

SITE DATA

Drainage area size 19 sq. mi., 12,160 acres. Type of structure 6'x6' D.I Purpose Recreation, FWR

Direction of valley trend (downstream) S Maximum height of fill 41 feet. Length of fill 2100 feet.

Estimated volume of compacted fill required 148,536 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	619.0	154	21
Floodwater	3,070	448	31.4

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Dissected Till Plain Topography Rolling Attitude of beds: Dip — Strike —

Steepness of abutments: Left ± 60 percent; Right 24 percent. Width of floodplain at centerline of dam 500 feet

General geology of site: The site is located in National Soil Province #52, the Missouri & Iowa Loess Till Plain. The soil mantle is composed of loess underlain by glacial till. The till contains a mixture of clay, silt, sand, gravel, and boulders. Cobbles were encountered in the auger holes but boulders are rarely encountered. Sand or sandy till may occur on the slopes but is unlikely at depths of 10 to 20 feet. Bedrock outcrops are limited to the valley floor.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

G - L - 2 M
C - 3

FORM SCS-376B
REV. 2-64
SHEET 2 OF 4

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE 2 Fill, prin. spillway, Emerg. spillway, channel, drainage, borr.
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
	EXPLORATION	SAMPLING	UNDISTURBED (STATE TYPE)	DISTURBED LARGE	DISTURBED SMALL
6" Slat Auger	16	4		9 Bag	
2" Split Tube		6			24 Jar
3" Shelby		1	3		
2½ Iwan HA	4				
TOTAL	20	11	3	9	24

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The stiff glacial Till occurs on the right abutment, the steep escarpment to the left of the channel and in the foundation to the left of Station 12+00. The till underlies the alluvium of the valley floor. The upper alluvium in test holes 9, 11 & 12 was classified as SM-ML and had blow counts of 9 & 10 in test hole #9. The lower alluvium is classified as medium and becomes wet & soft with depth except in test hole #6 where the blow count was 6 & 8. The fine textured alluvium is underlain with silty or slightly silty sand, classified SM from approximate centerline stations 13+00 to 20+00. The sand had blow counts ranging from 2 to 5. A stiff fine gravel occurs below the sand in test holes from centerline station 14+00 to 19+00. The upper fine textured alluvium ranged in depth from 22 to 28 feet. The depth to the underlying till ranged from 31 to 36 feet. The alluvium forms the foundation of the principal spillway. The emergency spillway is in till. The alluvium of the valley floor is the chief source of borrow material and sufficient quantities are available. The water levels as measured at the time of the investigation were high because of seasonal and recent heavy local rains. The stratum

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

G-L-& M
C-3

FORM SCS-376B
REV. 2-64
SHEET 2 OF 4

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE _____

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
TOTAL					

SUMMARY OF FINDINGS

(INCLUDE ONLY FACTUAL DATA)

is stable to aggrading. Stream channel deposits of soft silts with organic debris are three feet or less deep.

Form SCS-376C
Sheet 2 of 4
For In-Service Use Only

USDA-SCS

10-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Missouri County Dekalb Co Watershed Grindstone Creek-Long Subwatershed

Site number 1-3 Site group I Structure class b Investigated by [signature and title] Date 4-30-81

INTERPRETATIONS AND CONCLUSIONS

The SC encountered in test holes #3, 4 & 13 and the SM which occurs at depth in test hole #4 are thin lens typical of the till in the area and do not present any seepage hazard. The fine textured alluvium classified CL differs widely in consistency. All drives into the material were satisfactory and the blow counts are valid. Blow counts in the underlying SM are mostly 2 & 3. The blow count of 5 in Test hole 302 may not be valid since the sampler dropped 1.7 feet before the drive. Efforts to take a Shelby sample in this material were not successful. Sample #302.11 was obtained by an excessive push and packing in the Shelby tube. Undisturbed samples were taken at the intercept of the principal spillway and the ℄ of the dam. Samples 302.8 and 302.9 appeared to be good samples and are representative of the soft yellowish brown and gray clays encountered throughout the alluvium in the foundation area. The sands were found in Test holes #201, 303, 601, & 602 and underly the foundation area and probably occur at depth throughout the reservior area. The alluvium which is the principal source of borrow material, is generally uniform and all borrow holes were not sampled. Estimates on borrow available were made to a depth of 4 feet and to Grid K, below the crest elevation of the principal spillway. There are an estimated 165,000 cubic yards of compacted fill available in this area. The stream channel is stable to aggrading. Material classified as channel deposits are three feet or less in depth.

APPENDIX E

DIVISION II

SOILS REPORT

USDA - SCS

MAY, 1968

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : James M. Dale, State Conservation Engineer, SCS, Columbia, Missouri

DATE: July 19, 1968

FROM : Lorn P. Dunnigan, Head, Soil Mechanics Laboratory, SCS, Lincoln, Nebraska

SUBJECT: ENG 22-5, Missouri WP-08, Grindstone-Lost-Muddy Creek Watershed, Site No. C-3 (Gentry and Dekalb Counties)

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 4 sheets.
2. Form SCS-128, Consolidation Test Data, 12 sheets.
3. Form SCS-127, Soil Permeability, 3 sheets.
4. Form SCS-355, Triaxial Shear Test Data, 5 sheets.
5. Form SCS-352, Compaction and Penetration Resistance Report, 9 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 3 sheets.

DISCUSSION

FOUNDATION

A. Classification: The foundation material at this site consist of glacial till on the abutments and alluvium overlying glacial till in the floodplain. The alluvium has a maximum thickness of about 35 feet.

The Kansan till is field classified as CL and reportedly contains about 25 to 30 percent coarse material. The alluvium as represented by samples from holes 6, 8, 9 and 302 consists of CH, CL, SM and SP-SM. The CL's range from sandy, low plasticity CL like that sampled from the 22 to 23-foot depth in test hole 5.1 (69W21) to CL that contains 95 percent fines and has a liquid limit of 48 and a PI of 26 like sample 69W17 from the 12 to 14-foot depth in test hole 302. The CH is quite fine grained and it has liquid limits in the range of 61 to 64 and PI's of from 38 to 42. The CL and CH materials overly the sandy zone of alluvium. It appears that the CH occurs mainly on the right side of the floodplain and the CL occurs mainly on the left side of the floodplain. Eight samples were submitted from the sandy zone that lies between the CH and CL alluvium and the till in the bottom of entrenchment. One of the samples represented a stratum of CL within the sand. Three of the samples are low to non-plastic SM that contain from 27 to 33 percent fine and about 8 percent finer than 0.002 mm. The other four samples contain from 8 to 18 percent fines and are classed as SP-SM and SM.

The CL and CH surface zone ranges from more than 20 feet to about 25 feet thick and the sandy zone ranges up to 14 feet thick.

B. Density and Blow Count: Three cores were submitted from the CL zone in test hole 302.

The density and blow count data for the core samples is summarized as follows:

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Sample No.	Sample Depth	% Fines	LL	PI	γd of Test Specimens g/cc	Standard Penetration Resistance (blows/foot)
69W16	5 - 7 feet	67	29	13	1.55 to 1.57	12
69W17	12 - 14 feet	95	48	26	1.46 to 1.52	4
69W18	18 - 20 feet	53	35	16	1.51 to 1.57	3

Blow counts of less than three blows per foot were recorded for a sandy CL at the 22 to 23-foot depth in test hole 5 and in the SM in test holes 6 and 9. The low blow count material (two blows per foot) is not represented by samples. Attempts to sample with a shelby tube were unsuccessful.

C. Shear Strength: Consolidated undrained triaxial shear tests were made on the three core samples submitted. The test data are summarized as follows:

Sample No.	Test γd (g/cc)	Degree of Saturation (%)	Shear Strength Parameters Ø deg	c(psf)
69W16	1.55-1.56	93.3 - 95.4	13.5	1500
69W17	1.46-1.52	93.5 - 98.1	10.5	675
69W18	1.51-1.57	94.2 - 100.0	22.0	100

The tests were made on the material at natural moisture content. The test data appear to correlate well with the blow count data in that the lower strength material has a low blow count also.

D. Consolidation: Consolidation tests were made on the three core samples submitted. The test data indicate that the sample from the 5.0 - 7.0-foot depth has been preconsolidated to at least 3600 psf. Preconsolidation is apparently due to dessication. The data for the other two samples indicate near normally consolidated materials. This data correlates well with blow count. The preconsolidated material has blow count in the range of 12, whereas the near normally consolidated material has a blow count in the range of 3 and 4 blows per foot.

The consolidation potential at centerline station 15+55 (test hole 302) was estimated. The test data indicate that the consolidation potential of the CL stratum at this location is about 0.8 foot. If the consolidation potential of the sandy zone is assummed to be the same as that of the sandy CL (sample 69W18) which directly overlies the total foundation consolidation will be in the range of 1.3 feet. The Kansan till has been assumed to be non-lielding for the proposed fill height.

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Based on the site investigation data and the test data it appears that most foundation consolidation will occur near the center of the valley. Kansan till is relatively shallow in the channel area on the left side of the floodplain and high blow count CH is prevalant on the right side of the floodplain. Based on blow count and the test data from CL sample 69W16 we would expect the consolidation potential of the CH to be less than 0.01 ft/ft.

E. Permeability: Falling head permeability tests were made on the consolidation test specimens during the test. The data obtained are reported on the attached Form SCS-127. The tests indicate vertical permeability rates of from about 0.001 fpd to 0.005 fpd.

The sandy stratum is somewhat stratified and the permeability of this stratum may be expected to be variable. Based on the D_{10} size we estimate that it will range from less than 0.05 fpd to about 25 fpd.

EMBANKMENT

A. Classification: The borrow material will consist primarily of alluvium. Nine samples were submitted to represent the proposed borrow area. The materials represented range from CL with an LL of 43 and a PI of 18 to CH with an LL of 59 and a PI of 38. The surface 2.0 to 2.5-foot zone is apparently less plastic and slightly coarser grained than the underlying material as indicated by samples 69W35 and 69W41. These materials are quite susceptible to volume change with changes in moisture content as indicated by shrinkage limit tests on samples 69W35, 69W38 and 69W39. Samples 69W38 and 68W39 have shrinkage limits of 10 and 13 and this is considerably below standard Proctor optimum moisture for these samples which are in the range of 19. Sample 69W35 has a shrinkage limit of 23 which is slightly higher than Proctor optimum moisture. The shrinkage limit on sample 69W35 is somewhat higher than normal for material with this LL and PI. This may be due to the fact that sample 69W35 represents a surface soil and with a higher organic content the susceptibility to shrinkage may be less.

B. Compacted Density: Standard Proctor compaction tests were made on all of the samples submitted. The maximum dry density obtained ranged from 96.5 pcf to 108.5 pcf.

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C. Shear Strength: Consolidated undrained triaxial shear tests were made on CL sample 69W35 and on CH sample 69W38 to represent the range of materials submitted. The tests were made at 95 percent of standard Proctor density at saturation. The test data obtained are summarized as follows:

Sample No.	Classification	Test γ_d % Proctor	Degree of Saturation	Shear Strength Value Ø deg	c psf
69W35	CL	94.7	91.2-92.5	19	875
69W38	CH	95.1	96.6-97.7	5	925

SLOPE STABILITY

The stability of the proposed slopes was checked with a Swedish circle method of analyses. Analyses were made for the embankment only at the maximum section and for the embankment and foundation at the centerline station 15+50 section. A phreatic line was assumed from emergency spillway elevation to a drain at c/b = 0.6 and drying cracks were assumed from the embankment surface to the phreatic line as shown on the attached slope stability summary.

For the section at centerline station 15+50 the foundation strength was assigned in accordance with the shear test data for each stratum. The lowest factor of safety obtained for either slope was 1.83 and this was obtained on upstream slope for the embankment only section. Full drawdown was assumed. The factor of safety of a 2 1/2:1 downstream slope without a drain would be in the same range as that obtained on the 2 1/2:1 upstream slope with the full drawdown condition. A summary of the analyses is attached.

SETTLEMENT ANALYSES

The test data indicate that the CL alluvium at centerline station 15+50 will consolidate about 0.8 foot under the proposed loading. Based on a comparison of blow count, we estimate that the CH stratum at centerline station 18+50 has a consolidation potential of less than 0.25 foot and that the consolidation potential of the CL at centerline 14+20 may be intermediate between 0.8 foot and 0.25 foot. We assume that the consolidation potential of the sandy zone at the three locations referred to above will be comparable although this is not known for sure because undisturbed samples were not obtained.

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Subj: ENG 22-5, Missouri WP-08, Grindstone-Lost-Muddy Creek Watershed, Site No. C-3

Based on field classification and deleniation of material, the low blow count CL (N=2) encountered in test hole #2 is present in channel area. A comparison of material indicates that the consolidation potential of this type of material will probably exceed 0.06 ft/ft. If so, the consolidation potential at centerline station 10+60 could approach 0.4 foot in the alluvium overlying Kansan till.

SEEPAGE ANALYSES

The factor of safety against heaving at the downstream toe was computed with the blanket aquifer equation. The assumptions were k_b = 0.001 fpd, k_f = 100 fpd, thickness of blanket = 22 feet, thickness of aquifer = 14 feet, reservoir head = 23 feet. Based on these conditions, the factor of safety against heaving was 1.91.

Seepage losses were very roughly estimated using Darcy's equation $Q = kia$. Assuming a hydraulic gradient in the aquifer of about 0.1 and a k of 100 fpd, the computed seepage loss is 1.1 cfs for a 14-foot thick aquifer 700 feet wide. If a hydraulic gradient of 0.01 is assumed, the computed seepage loss is 0.11 cfs for the same conditions. A gradient of 0.1 is about equivalent to the short path from the upstream toe to the downstream toe through the aquifer. The 0.01 gradient is slightly larger than gradient in the aquifer computed with the blanket aquifer equations. Based on these assumptions the computed seepage loss through the aquifer falls in the range of 0.1 to 1.0 cfs. Estimates computed in this manner should probably be doubled if seepage losses are a factor in design. It's significant that the seepage losses estimated above are based on an assumed permeability rate, and if more accurate losses are required then field permeability tests should be made in several locations to determine the permeability of the aquifer and the permeability of the natural blanket.

CONCLUSIONS AND RECOMMENDATIONS

A. Site Preparation: The left abutment is relatively steep in some areas. We suggest that it be flattened to obtain a uniform slope and to facilitate bonding between fill and foundation.

B. Cutoff: In general we concur with the cutoff depths suggested in the engineers investigation report for this structure. The suggested trench depth is relatively shallow on the left side of the floodplain and this is an area of CH soils. We suggest careful examination of the trench in this area during construction to insure that the trench bottoms below drying cracks that may exist. We suggest that the trench backfill be compacted to a minimum of 95 percent of standard Proctor density. The borrow materials are quite susceptible to cracking upon drying so we suggest that extra precautions be taken to insure that cracking does not occur in the natural material or in

the fill during placement. A placement moisture content near optimum is suggested.

C. Principal Spillway: The proposed conduit location crosses the centerline of dam at centerline station 15+55. The total consolidation potential at this location is estimated to be in the range of 1.3 feet. The investigational data indicates that the foundation conditions along the proposed alignment are fairly uniform.

The potential conduit elongation has been estimated to be in the range of 0.015 ft/ft at the proposed location. This estimate assumes a compressible foundation 33 feet thick with a consolidation potential of 1.3 feet.

The blow count data obtained in test hole 9 indicates that the foundation consolidation will be significantly less at centerline station 18+50 than at the proposed location, centerline station 15+55. Based on a comparison of blow count and consolidation test data for sample 69W16 we estimate the consolidation potential at centerline station 18+50 will be in the range of 0.75 foot. These data indicate a potential elongation in the range of slightly less than 0.009 ft/ft.

If it is possible to shift the conduit to the vicinity of centerline station 18+50 additional blow count tests should provide a good basis for determining foundation conditions. If the conduit is located in the CH area then the trench should bottom below the zone of cracking and backfill should be like that suggested under cutoff.

D. Drainage: The cutoff trench will bottom in slowly permeable CL and CH throughout its length and computations, based on an assumed permeability in the sandy stratum, indicate that uplift at the toe will not be a problem with the proposed reservoir height unless the conditions upstream and downstream are significantly different than at centerline. The investigational data does not show a need for a drain and a drain would result in more underseepage. There are two reasons why you may want to consider a drain, however, (a) to keep the downstream toe dry and (b) the preconsolidated surface zone of alluvium may be quite brittle and subject to cracking with non-uniform foundation consolidation. The magnitude of differential consolidation in the alluvium is not known.

A trench drain located at about c/b = 0.6 that penetrates the foundation about 4 or 5 feet would help protect against either of these conditions.

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E. Embankment Design:

1. Placement of Materials: The borrow materials represented by samples submitted should be placed as homogeneously as possible. As pointed out previously these materials are susceptible to cracking upon drying and for this reason it would be desirable to place the CH in the interior section if possible. The test data indicate that the surface soil like sample 69W35 is less susceptible to cracking than the deeper soils and for this reason we suggest that surface soils be placed at the surface of the embankment if possible.

   We suggest that all of the materials be placed at a minimum of 95 percent of standard Proctor. Placement should be near optimum. We suggest extra precautions to prevent drying cracks during placement.

2. Slopes: The data indicate that the proposed slopes have acceptable factors of safety.

3. Settlement: An overfill allowance of 1.25-foot is suggested to compensate for residual consolidation in the fill and foundation.

Prepared by:

Lorn P. Dunnigan

Attachments

cc:
James M. Dale, Columbia (2)
Project Office, Columbia
E. D. Butler, Lincoln

6/19/68

Ht. = 41 ft., Class B
148,536 cu.yds. Recreation, FWR

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MECHANICS LABORATORY DATA Sheet 2 of 4

MISSOURI (WP-08)

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Classification	Mechanical Analysis: Grain Size Distribution Expressed as Percent Finer by Dry Weight — Fines: #200 0.074 mm	#270 0.053 mm	0.02 mm	0.005 mm	0.002 mm	Sand: #140 0.105 mm	#60 0.250 mm	#40 0.42 mm	#20 0.84 mm	#10 2.0 mm	#4 4.76 mm	Gravel: 3/8" 9.525 mm	1/2" 12.7 mm	3/4" 19.05 mm	1" 25.4 mm	1 1/2" 38.1 mm	3" 76.2 mm	Atterberg Limits: LL	PI	Unified Classification	Soluble Salts %	Dispersion %	Moisture-Density Relationships: Standard / Modified: Optimum Moisture %	Max. Dry Density lb/cu ft	Optimum Moisture %	Undisturbed Sample Data: Dry Density lb/cu ft	Moisture %	Gs	Special Tests: Shear	Cons.
69W		Grindstone-Lost-Muddy, Site No. C-3																																	
15	301.1	℄ Prin.Splwy., 1+50, Jar	28-29		5	7	12	14	16	17	31	77	99	100																		21.2				
16	302.7	℄ Fill, 15+55 Core	5-7		18	23	39	50	67	73	94	99	100									29	13	CL						156	26.6	Shear 265	✓		✓	
																												S= 1.55						
																												C= 1.51						
17	302.8	℄ Fill, 15+55 Core	12-14		32	45	80	94	95				100									18	96	CL						146	9.0	Shear 267	✓		✓	
																														151	25.8				
																												S= 1.46						
																												C= 1.41						
18	302.9	℄ Fill, 15+55 Core	18-20																																
					8	24	31	45	49	53				100								35	16	CL						157	26.0	Shear 265	✓		✓	
																												S= 1.51						
																												C= 1.51						
19	302.10	℄ Fill, 15+55 Jar	28.6 29.5		3	4	8	8	10	11	20	50	94	100																20.3				
20	302.11	℄ Fill, 15+55 Jar	28 - 30.5		2	8	14	15	18	19	21	45	75	94	98	99	100					18	2	SM						110					
21	5.1	℄ Fill, 13+00 Jar	22-23		14	18	31	50	62				100									25	8	CL						134					

Form SCS-394
Rev. 3/58

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SOIL CONSERVATION SERVICE

SOIL MECHANICS LABORATORY DATA

6/19/68

MISSOURI (WP-08)

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Class Identification	Mechanical Analysis — Grain Size Distribution Expressed as Percent Finer by Dry Weight: Fines					Sand					Gravel						Atterberg Limits: LL	PI	Unified Classification	Soluble Salts %	Dispersion %	Moisture-Density Relationships: ☐ Standard ☐ Modified: Optimum Moisture	Max. γd pcf	%	Undisturbed Sample Data: γd pcf	%	Gs	Special Tests
69W		Grindstone-Lost-Muddy, Site No. C-3																														
22	5.2	℄ Fill, 13+00	Jar	28-29	3	6	9	13	15	18	34	61	93	100																18.7		
23	6.1	℄ Fill, 14+20	Jar	6-7	22	27	58	80	99					100							36	14	CL							25.1		
24	6.2	℄ Fill, 14+20	Jar	12-13	23	29	55	80	86					100							36	18	CL							26.3		
25	6.3	℄ Fill, 14+20	Jar	18-19	25	32	60	88	97					100							39	18	CL							26.7		
26	6.4	℄ Fill, 14+20	Jar	24-25	7	11	18	26	30	34	63	94	100								NON PLASTIC		SM							22.1		
27	8.1	℄ Fill, 17+00	Jar	19-20	16	21	35	64	75					100							29	9	CL							22.2		
28	8.2	℄ Fill, 17+00	Jar	25.5 to 26.5	7	11	19	26	27	31	52	92	99	100							NON PLASTIC		SM							23.0		

Form SCS-356
6/19/68

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SOIL MECHANICS LABORATORY DATA

MISSOURI (WP-08) — LOCALITY AND DESCRIPTION

Grindstone-Lost-Muddy, Site No. C-3

LABORATORY SAMPLE NUMBER	FIELD NUMBER	LOCALITY AND DESCRIPTION	DEPTH	FIELD CLASS OR LOCATION	MECHANICAL ANALYSIS — GRAIN SIZE DISTRIBUTION EXPRESSED AS PERCENT FINER BY DRY WEIGHT: FINES (3" mm, #200 0.074, #270 0.053, #325 0.044, #400 0.037, #500 0.025, #625 0.020, #1000 0.010, #1250 0.005, #2000 0.002)	SAND (#10 2.0, #18 1.0, #35 0.5, #60 0.25, #80 0.177, #120 0.125, #170 0.088, #230 0.062)	GRAVEL (3/8" 9.525, 1/2" 12.7, 3/4" 19.05, 1" 25.4, 1 1/2" 38.1, 3" 76.2 mm)	ATTERBERG LIMITS: LL	PI	UNIFIED CLASSIFICATION	SOLUBLE SALTS %	ORG. MOISTURE %	MOISTURE - DENSITY RELATIONSHIPS: METHOD	MAX. LB/CU FT	OPT. %	UNDISTURBED SAMPLE DATA: LB/CU FT	%	SPECIAL TESTS: SHEAR	SHEAR PSI (R)	SL	VOL. SHRINK (%)	L SH (%)
69W		Grindstone-Lost-Muddy, Site No. C-3																									
29	8.3	℄ Fill, Site 17+00	Jar	29-30		19	26	41	62	66					100					33	14	CL											
30	8.4	℄ Fill, 17+00	Jar	35-36		8	11	20	28	33	38	49	58	66	69	72	79	86	94	100		22	3	SM					12.9					
31	9.1	℄ Fill, 18+50	Jar	6-7		39	52	85	97	100												44	13	CH					25.7					
32	9.2	℄ Fill, 18+50	Jar	12-13		43	60	91	100													61	38	CH					30.1					
33	9.3	℄ Fill, 18+50	Jar	18-19		15	61	95	100													66	41	CH					31.9					
34	9.4	℄ Fill, 18+50	Jar	26-27		2	5	6	7	8	9	20	63	79	100														23.7					
35	103.1	Borrow C+50, 12+00, L. Bag		0-2		18	30	67	23	92					100							43	18	CL			D	96.5	2.0			✓	162	23	25.8	8.0

6/19/68

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MECHANICS LABORATORY DATA
Page 4 of 4

MISSOURI (WP-08)
Grindstone-Lost-Muddy, Site No.C-3

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Classification	Mechanical Analysis: Grain Size Distribution Expressed as Percent Finer by Dry Weight — Fines: .0002 mm	.0005	.002	.005	#200 .0074	Sand: #100 .015	#60 .025	#40 .042	#20 .084	#10 .19	#4 .46	Gravel: 3/8" .935	1/2" 1.3	3/4" 1.95	1" 2.6	1 1/2" 3.8	2" 5.0	Atterberg Limits: LL	PI	Unified Classification	Soluble Salts %	Dispersion %	Moisture Density Relationships: Std / Modified; Curve No.	Max. γd pcf	Opt. w %	Undisturbed Sample Data: γd pcf	w %	Gs	Special Tests: Shrink Ratio (R)	S.L.	Vol. Shrink. (%)	Lin. Shrink. (%)
69W																																					
36	103.2	Borrow, C+50, 12+00, L.Bag	2-6		30	39	70	91	95					100								46	25	CL			(2)	97.5	21.0			2.64				
		Alluvium																																			
37	105.1	Borrow, E+00, 20+00, L.Bag	0-4.5		38	47	78	93	95					100								52	38	CH			(3)	92.5	22.5			2.65				
		Alluvium																																			
38	105.2	Borrow E+00, 20+00, L.Bag	4.5-10		35	45	78	95	98					100								54	34	CH			(4)	102.5	19.5			2.65	✓	1.98	12	95.6	16.0
39	108.1	Borrow, I+00, Y+00, L.Bag	0-4		31	39	61	81	86					100								48	27	CL			(5)	100.0	18.5			2.62		1.85	13	66.8	14.0
		Alluvium																																			
40	108.2	Borrow, I+00, Y+00, L.Bag	4-8		30	37	62	83	87					100								51	33	CH			(6)	105.5	17.0			2.69				
41	110.1	Borrow, I+00, 22+00, L.Bag	0-2.5		26	31	58	77	86					99								47	22	CL			(1)	96.5	22.0			2.59				
		Alluvium																																			
42	110.2	Borrow, I+00, 22+00, L.Bag	2.5-6		40	49	76	89	93					100								57	36	CH			(3)	92.5	21.0			2.67				
43	110.3	Borrow, I+00, 22+00, L.Bag	6-9.5		28	35	54	75	89					100								44	24	CL			(9)	108.5	16.5			2.67				

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
[illegible]	19.2'-20.0'	Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]	LPD	7-18-68

CLASSIFICATION CL

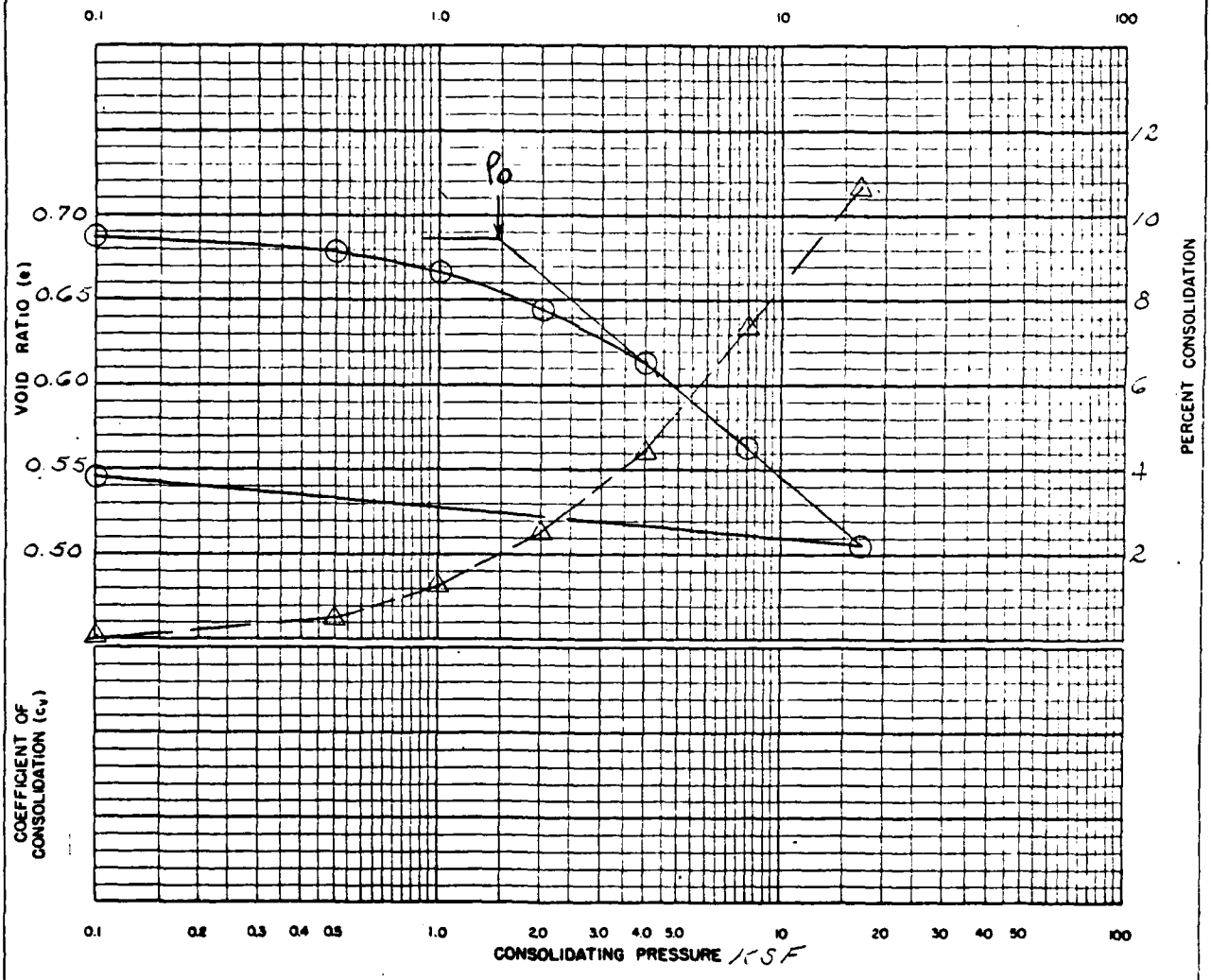
G_s [illegible] LL 35 PI 16

INITIAL DENSITY γ_d [illegible]

INITIAL VOID RATIO, e_o 0.6878

COMPRESSION INDEX, C_c 0.17

TEST SPECIFICATIONS:
Saturated at Start



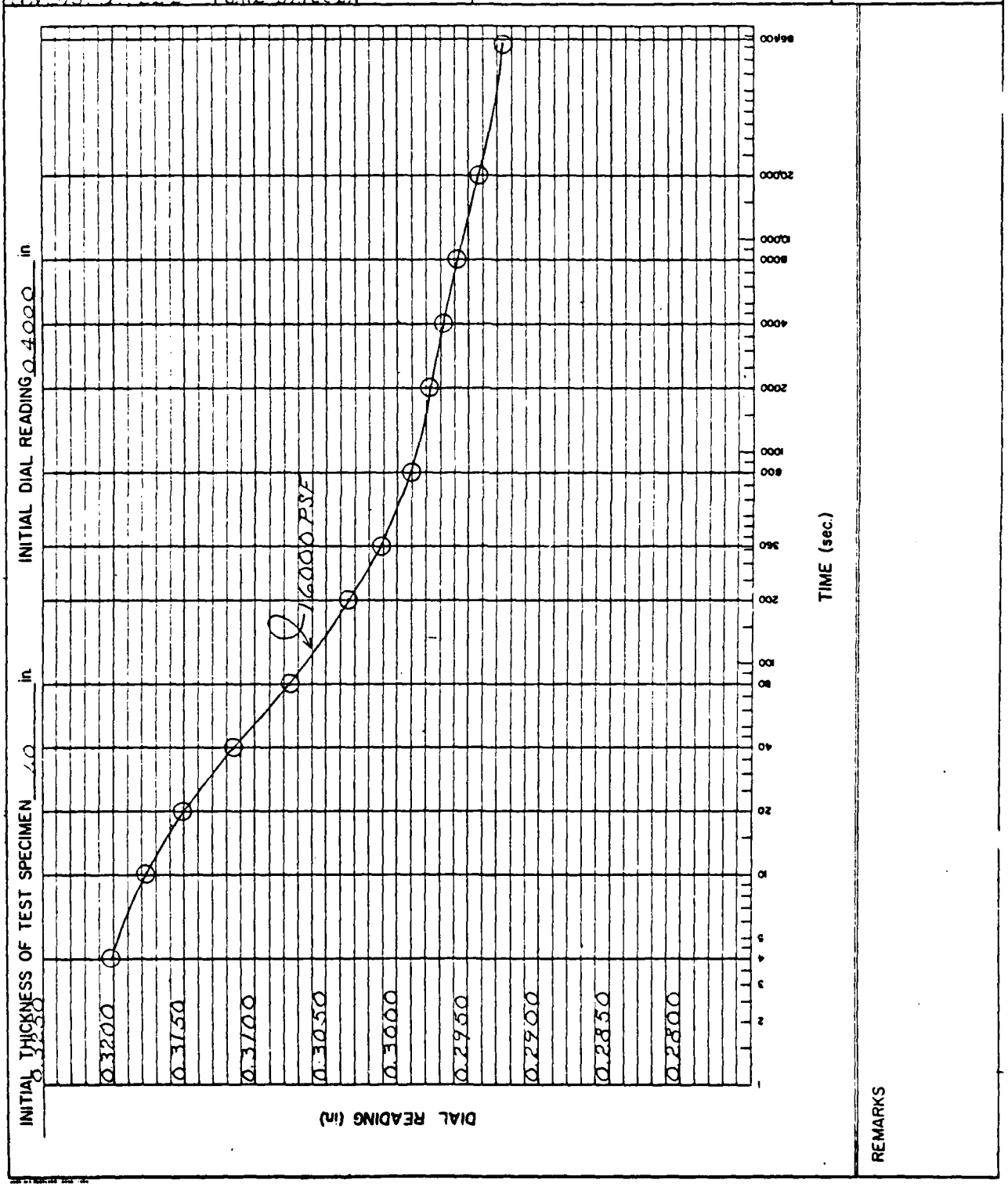
REMARKS

Form SCS-123A
4-64

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]		
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]		



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
		Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
		LPD	7-18-68

CLASSIFICATION

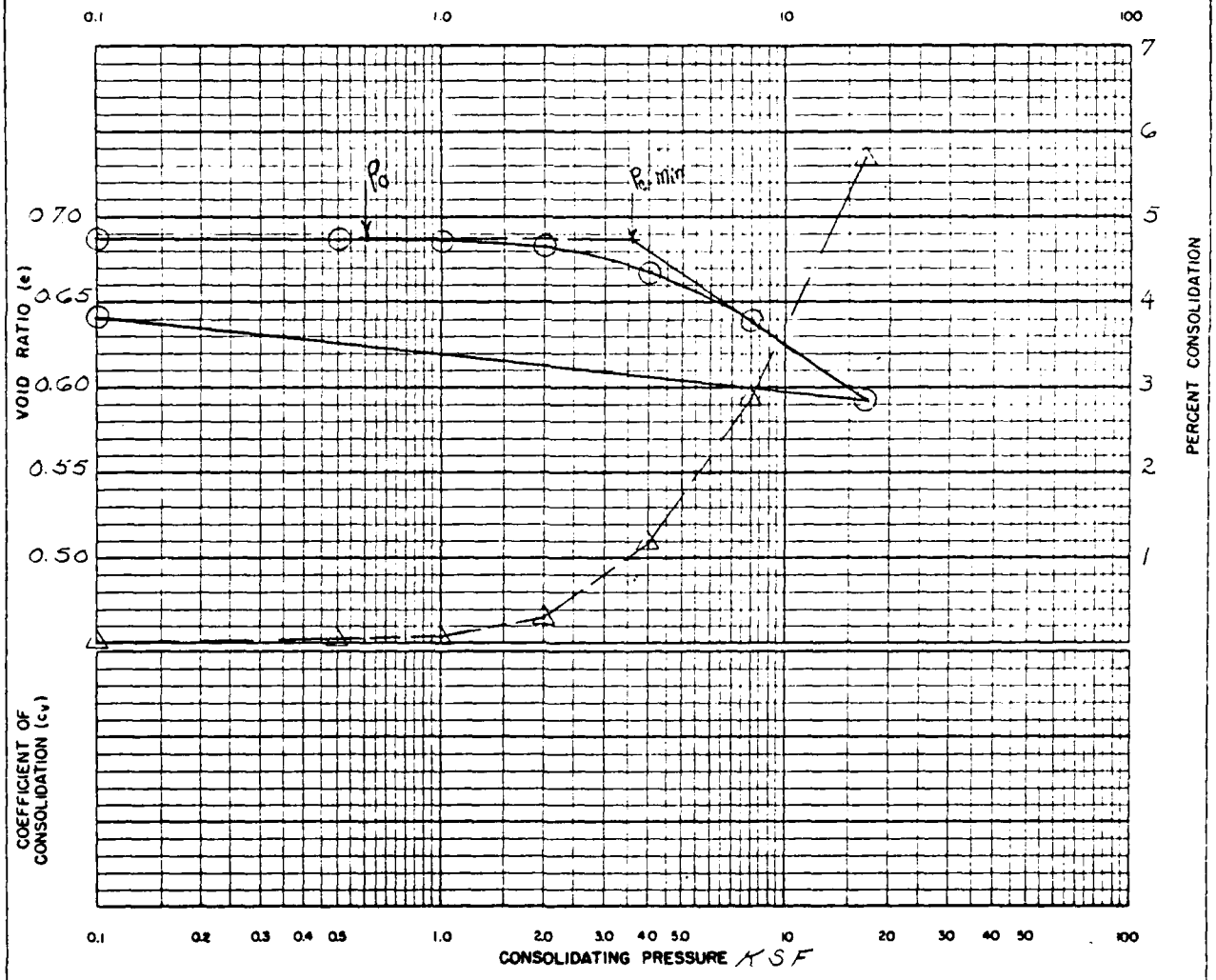
G_s LL PI

INITIAL DENSITY γ_d

INITIAL VOID RATIO, e_o 2.6878

COMPRESSION INDEX, C_c 0.137

TEST SPECIFICATIONS:
Saturated at Start

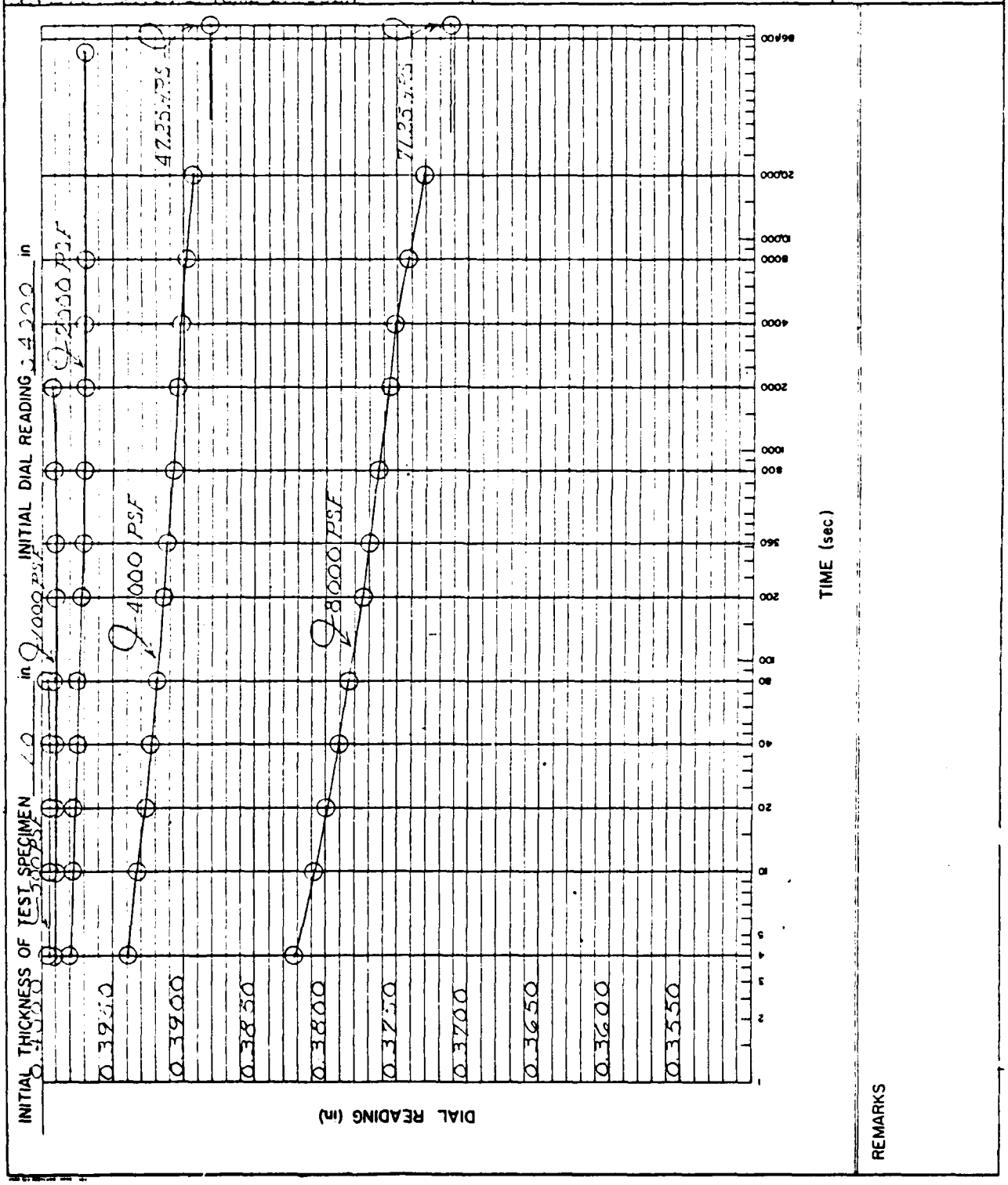


REMARKS

LABORATORY NO.

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE		SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN
TYPE OF SAMPLE	TESTED AT	APPROVED BY / DATE

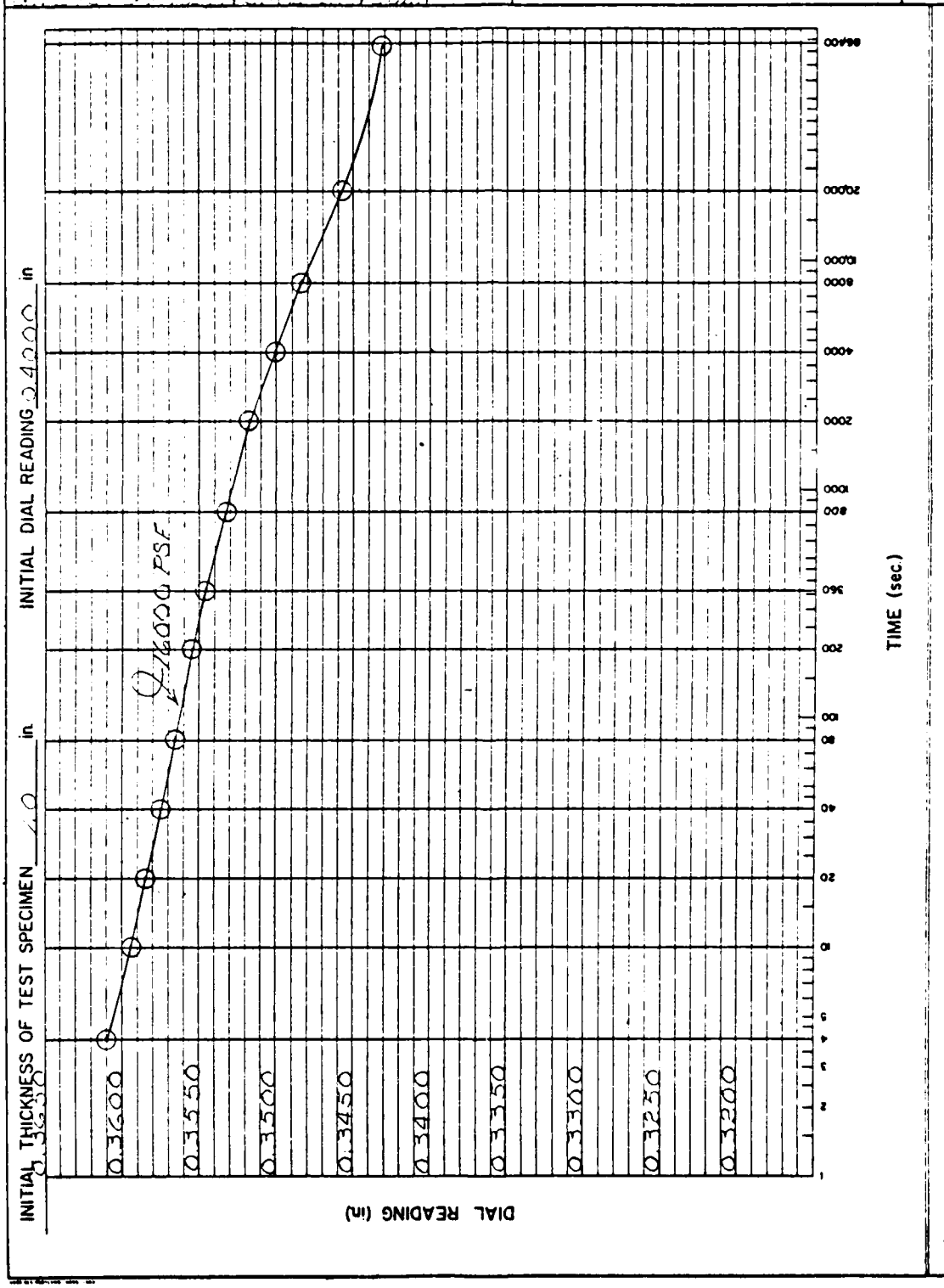


REMARKS

LABORATORY NO

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE



LABORATORY NO

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
		Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
		LPD	7-18-68

CLASSIFICATION

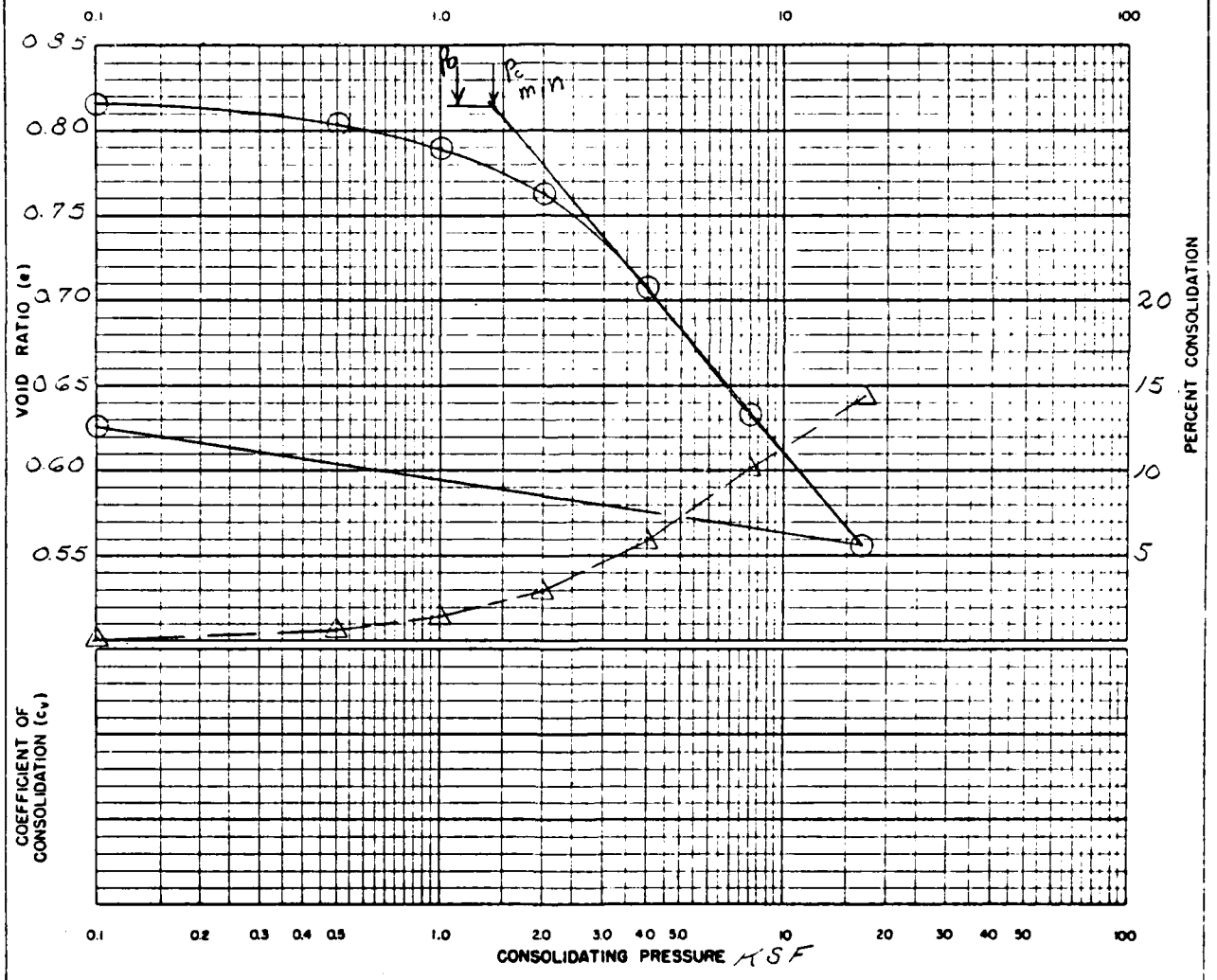
G_s LL 45 PI 26

INITIAL DENSITY γ_d

INITIAL VOID RATIO, e_o 0.862

COMPRESSION INDEX, C_c 0.195

TEST SPECIFICATIONS:
Saturated - Soak

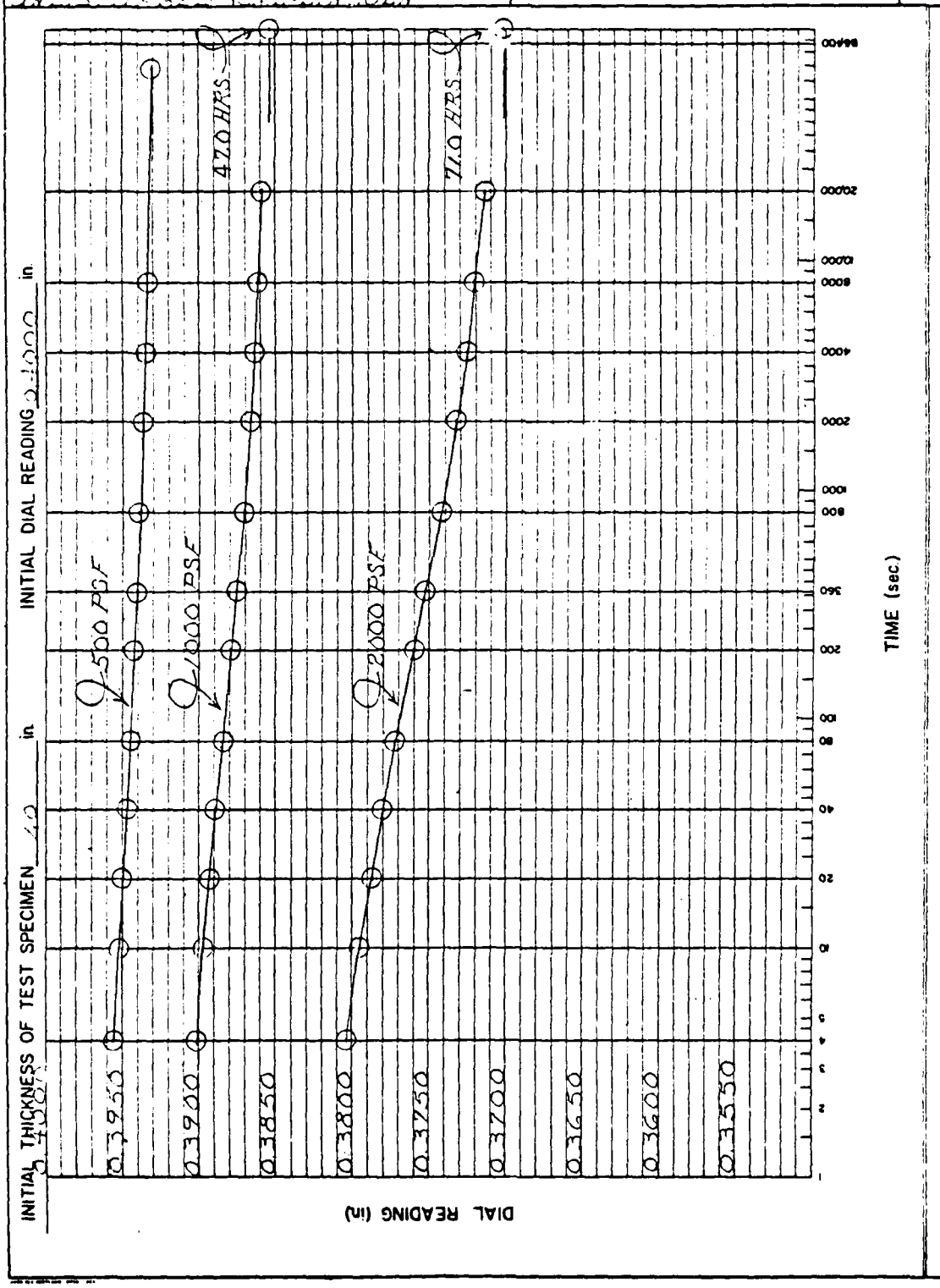


REMARKS

LABORATORY NO.

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

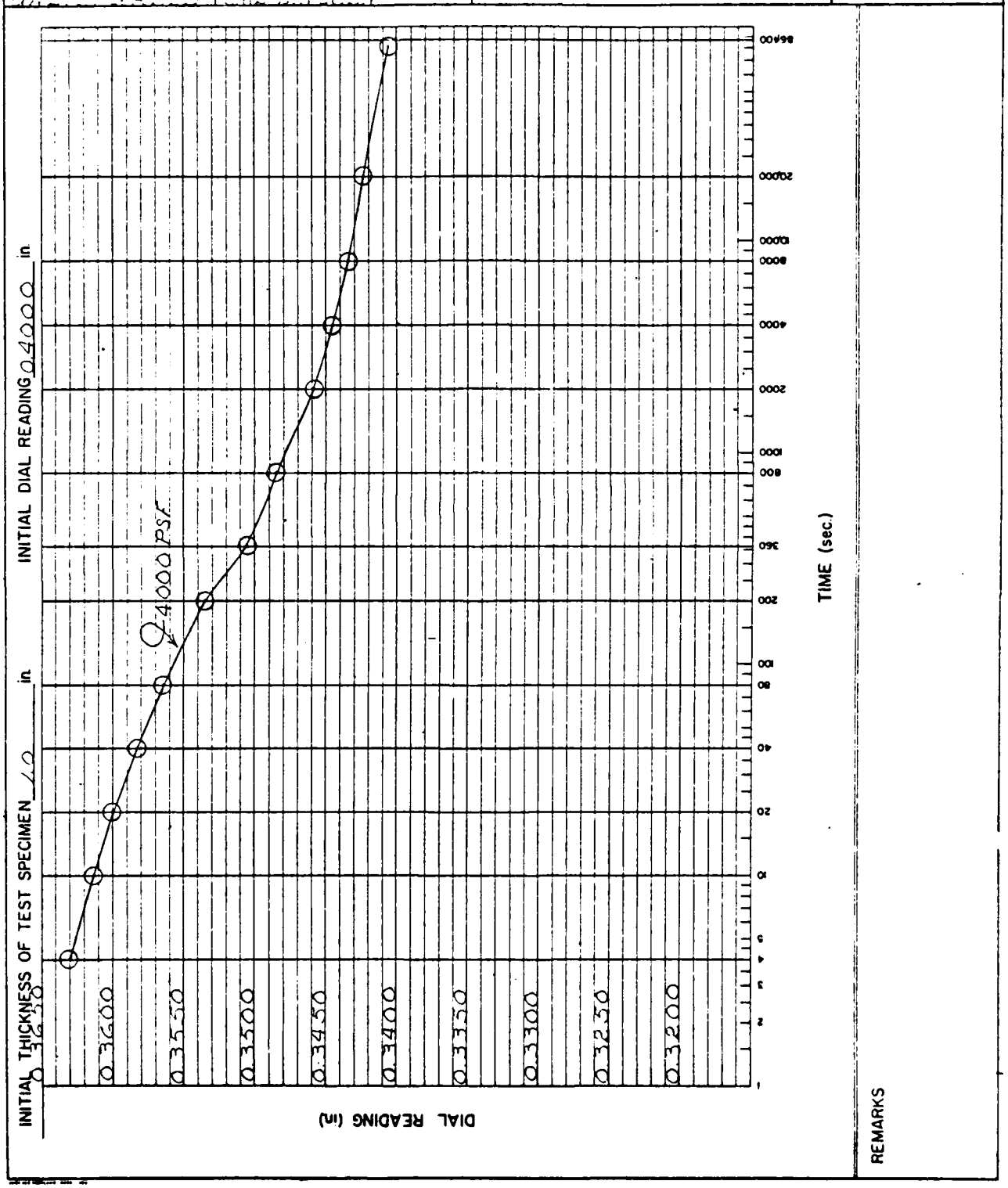
PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE



LABORATORY NO.

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE

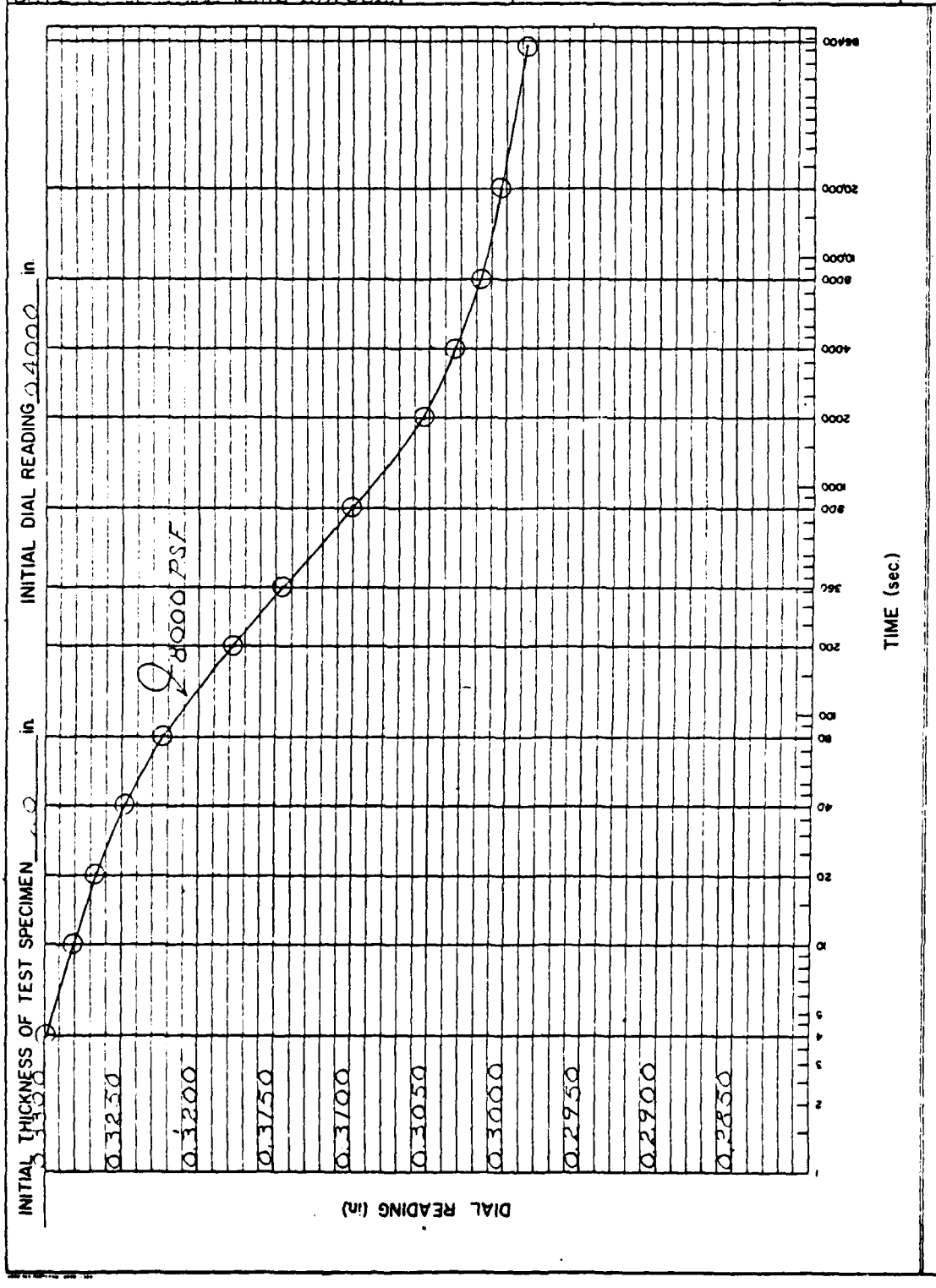


Form SCS 128A
(6-64)

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
[illegible]			CELL 5255
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
3028	12.0'-12.0'		
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	SMU-LINCOLN		

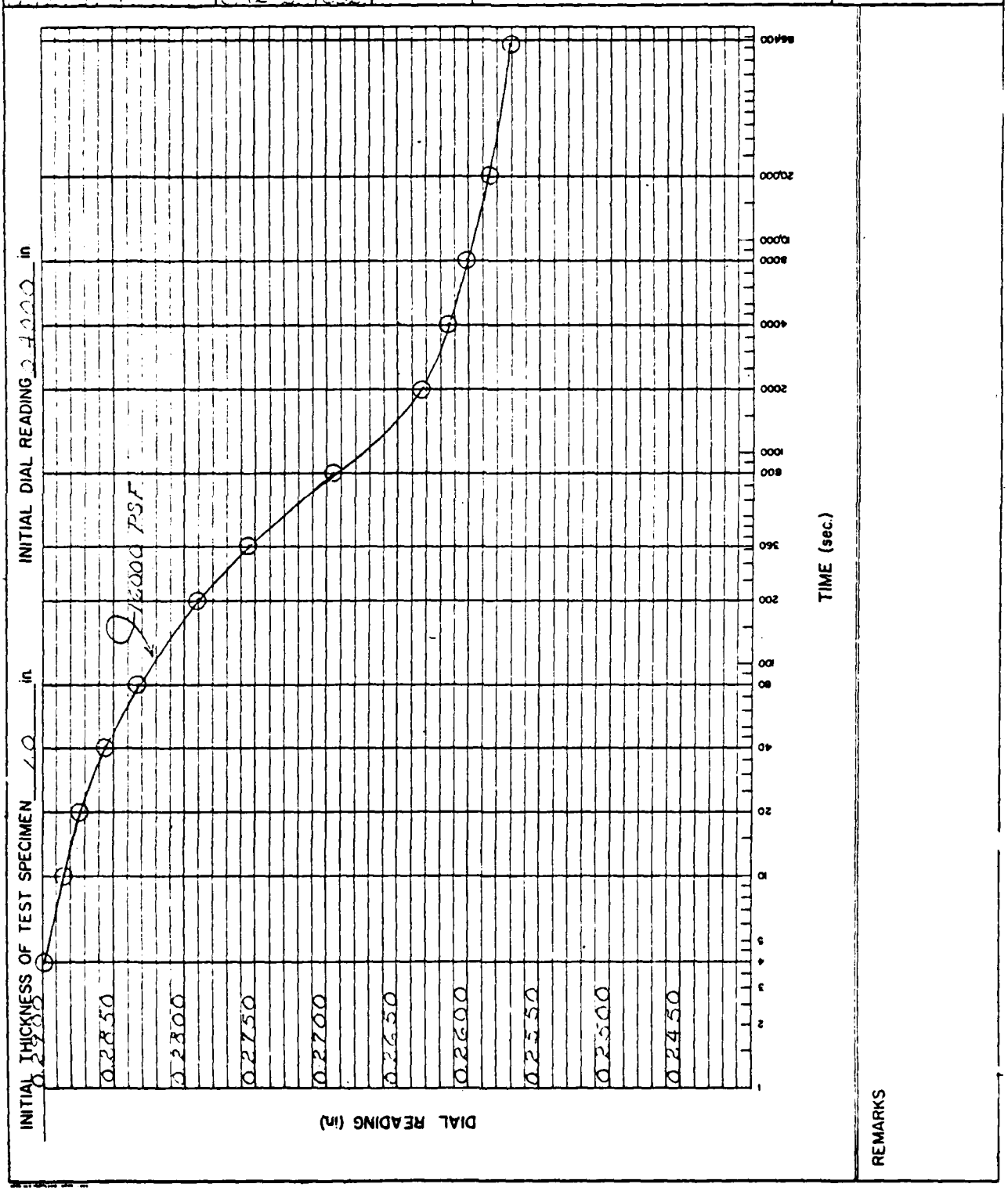


Form SCS-ICBA
6-64

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]		
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]		



REMARKS

LABORATORY NO 6-2117

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

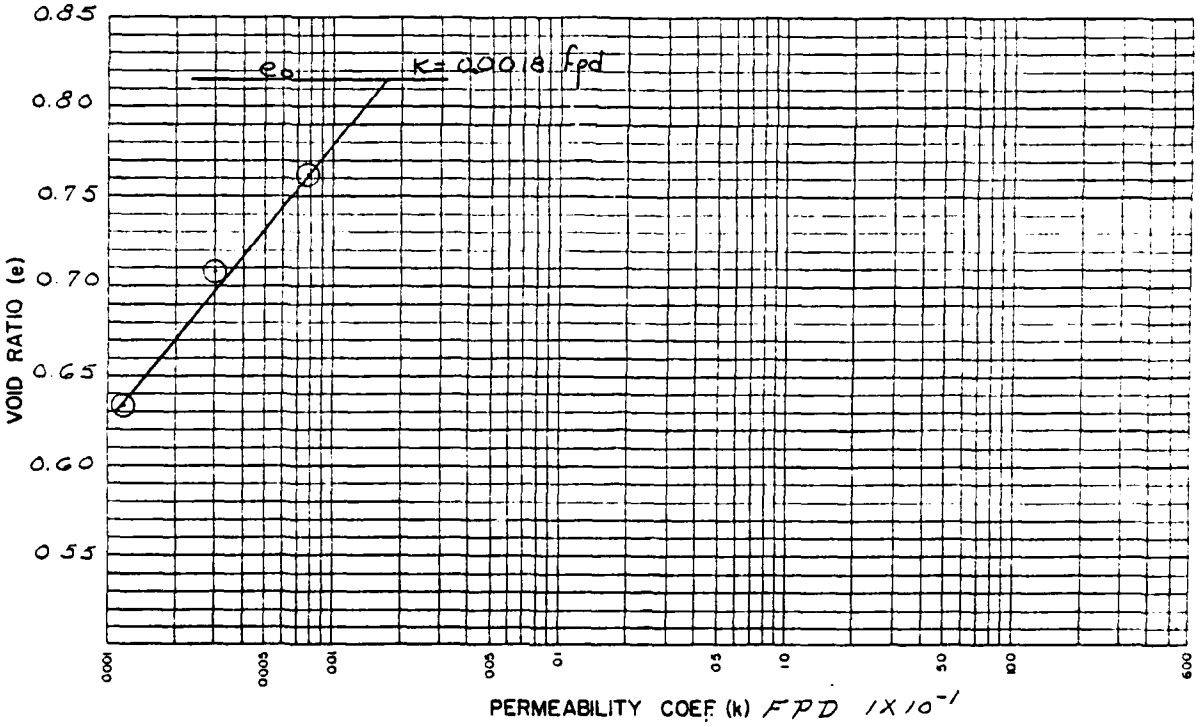
PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]	Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	SWL-LINCOLN	LPD	7-18-68

CLASSIFICATION CL LL 29 PI 26

SPECIFIC GRAVITY

TEST NO.	1	2	3	4	G_s (-) #4	2.67
INITIAL MOISTURE %					G_s (+) #4	
DRY DENSITY ☒ g/cc ☐ pcf	1.52	1.56	1.64		G_m(Bulk)(+) #4	
VOID RATIO	0.7619	0.7085	0.6324			
PERMEABILITY COEF FPD	0.00079	0.00030	0.00012			
PERCOLATION COEF						
H/L DURING TEST						

TEST SPECIFICATIONS
Falling Head Perm Test on the Consolidation Sample



REMARKS

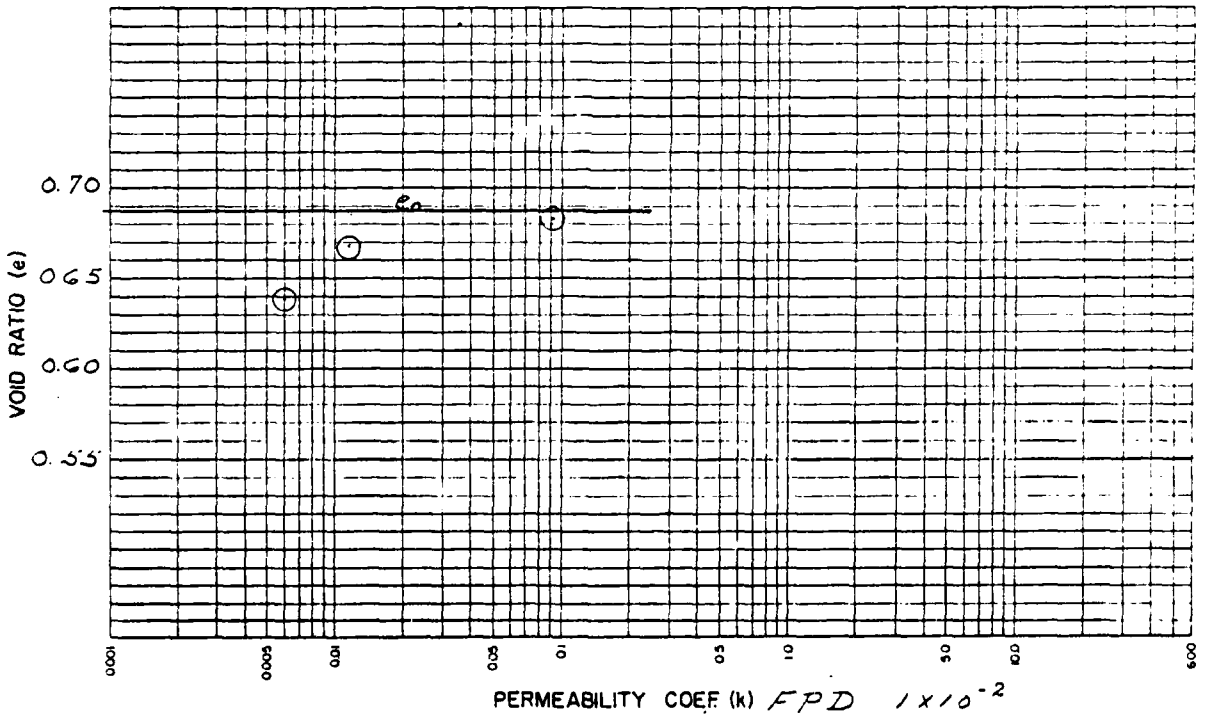
MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]'	Alluvium	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	Silt. Lincoln	LPD	7-18-68

CLASSIFICATION CL — LL 29 PI 13 — SPECIFIC GRAVITY

TEST NO.	2 1/2"	4 2"	6 3"	4	G_s (-) #4	[illegible]
INITIAL MOISTURE %					G_s (+) #4	
DRY DENSITY ☑ g/cc ☐ pcf	1.05	1.09	1.08		G_m(Bulk)(+) #4	
VOID RATIO	0.6525	0.6677	0.6392			
PERMEABILITY COEF FPD	0.00091	0.00012	0.00006			
PERCOLATION COEF						
H/L DURING TEST						

TEST SPECIFICATIONS
Falling Head Perm Test on the Consolidation Sample



REMARKS

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: [illegible] SAMPLE LOCATION: C FILL 15+55

FIELD SAMPLE NO: [illegible] DEPTH: 50'-200' GEOLOGIC ORIGIN: Alluvium

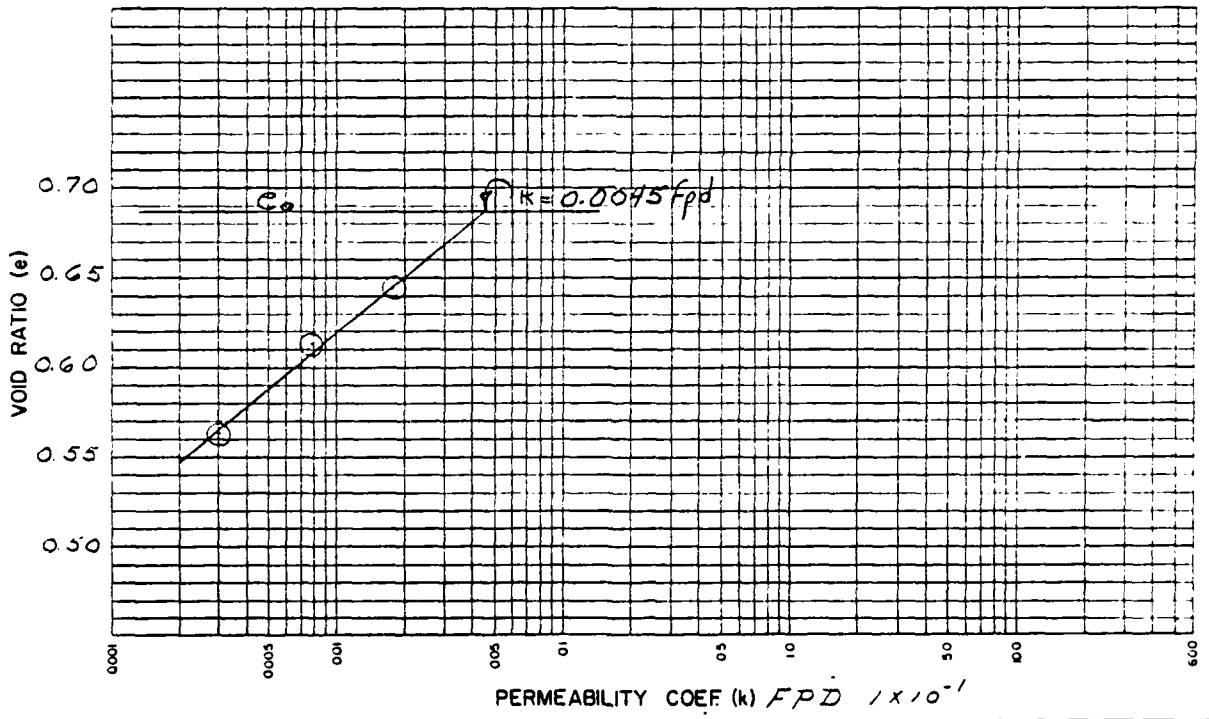
TYPE OF SAMPLE: [illegible] TESTED AT: SML-LINCOLN APPROVED BY: LPD DATE: 7-18-68

CLASSIFICATION CL LL 35 PI 16

TEST NO.	2000	4000	8000	4
INITIAL MOISTURE %				
DRY DENSITY ☒ g/cc ☐ pcf	161	164	170	
VOID RATIO	06447	06127	0.5632	
PERMEABILITY COEF	0.0018	0.00079	0.00030	
PERCOLATION COEF				
H/L DURING TEST				

SPECIFIC GRAVITY	
G_s (-) #4	2.65
G_s (+) #4	
G_m(Bulk)(+) #4	

TEST SPECIFICATIONS
Falling Head Perm Test on the Consolidation Sample



REMARKS

Form SCS 355 A
Rev 6-65

LABORATORY NO 6[illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: GRINESTONE - LAKE MUDDY SITE C-2 MISSOURI
SAMPLE LOCATION: E FILL 1.5+55

FIELD SAMPLE NO: 322.7
DEPTH: 5-7'
GEOLOGIC ORIGIN: ALLUVIUM

TYPE OF SAMPLE: UNDISTURBED
TESTED AT: SML-LINCOLN
APPROVED BY: LDC
DATE: 7-19-68

INDEX TEST DATA

USCS CL ; LL 29 ; PI 13
% FINER (mm): 0.002 18 ; 0.005 23 ;
0.074 (# 200) 67
G_s (-#4) 2.65 ; G_s (+#4) _____
STANDARD: γ_d MAX. _____ pcf; w_o _____ %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

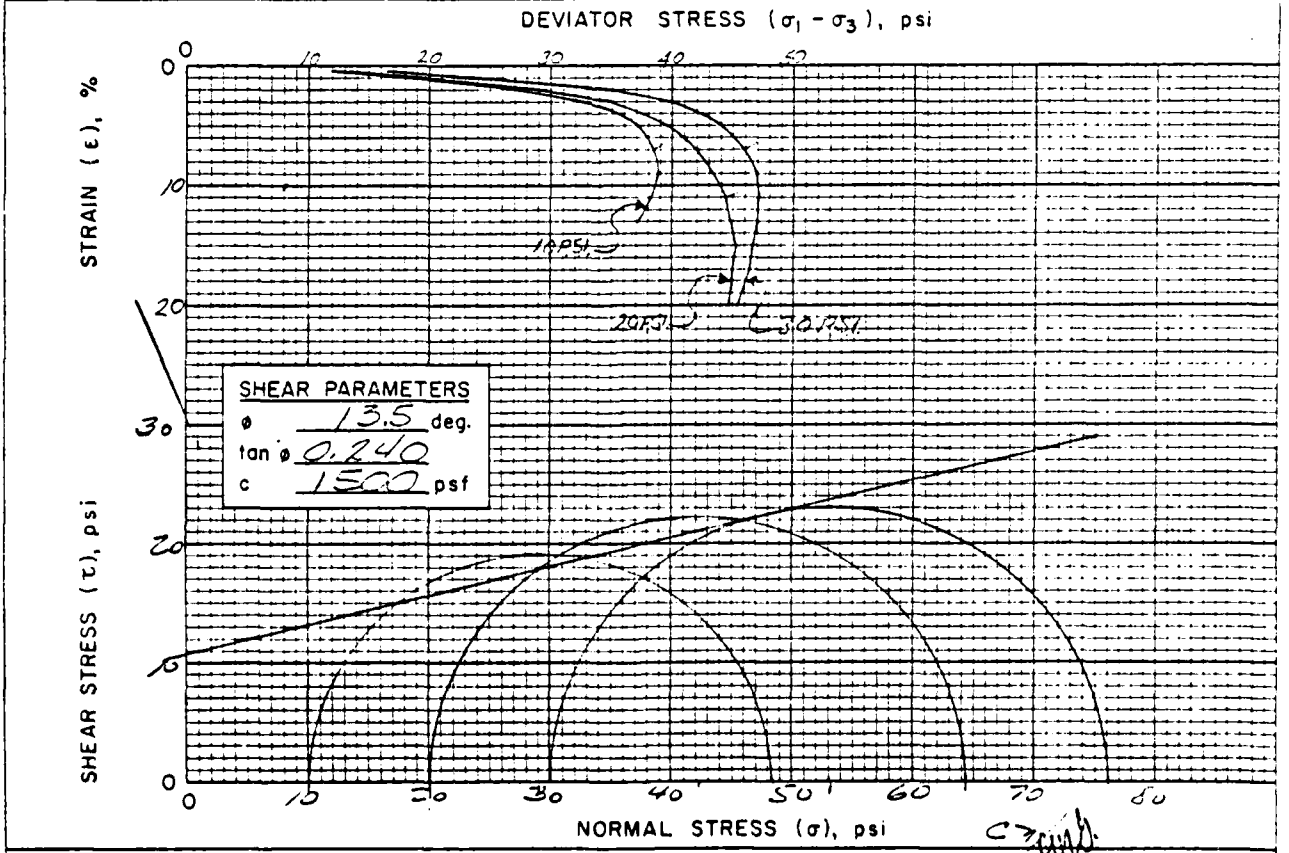
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION TRIMMED FROM AN UNDISTURBED CORE
MOLDING MOISTURE _____ %
MOLDED AT _____ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLI-DATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☐ g/cc ☑	CONSOLI-DATED pcf ☐ g/cc ☑		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
1.562	1.562		25.1	95.4	25.1	5.87	10	33.3	7
1.555	1.558		25.3	95.1	25.2	5.48	20	44.3	11
1.549	1.552		25.0	93.3	24.8	5.77	30	45.9	7



REMARKS TESTED @ NATURAL MOISTURE

FORM SCS 355-A
Rev. 8-65

LABORATORY NO [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: [illegible] SAMPLE LOCATION: E Fill 15+55

FIELD SAMPLE NO: 302.3 | DEPTH: 12 - [illegible] | GEOLOGIC ORIGIN: Alluvium

TYPE OF SAMPLE: [illegible] | TESTED AT: [illegible] - Lincoln | APPROVED BY: LPD | DATE: 7-19-68

INDEX TEST DATA

USCS CL ; LL 46 ; PI 26

% FINER (mm): 0.002 37 ; 0.005 45 ; 0.074 (#200) 95

G_s (-#4) 2.67 ; G_s (+#4) _____

STANDARD: γ_d MAX. _____ pcf; w_o _____ %

MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1 1/2 "

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION TRIMMED FROM AN UNDISTURBED CORE

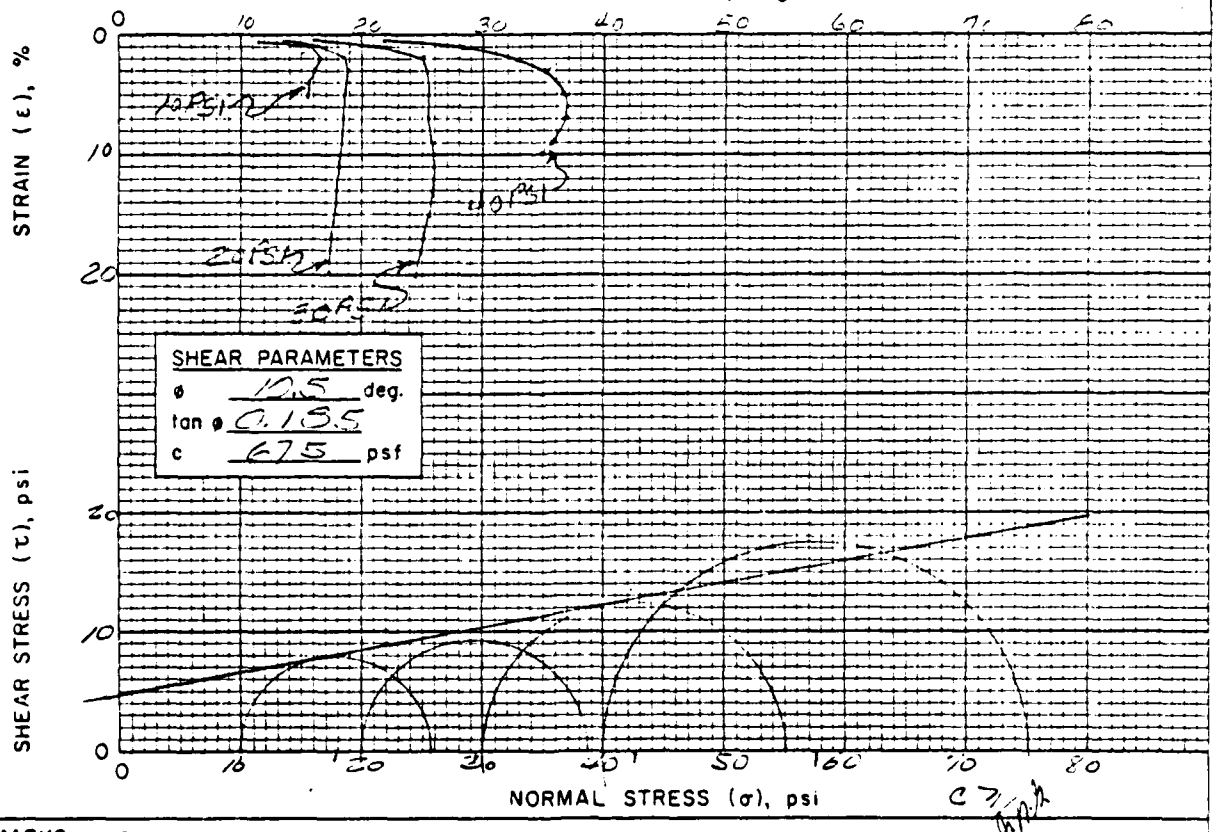
MOLDING MOISTURE _____ %

MOLDED AT _____ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐ CU ☑ $\overline{CU}$ ☐ CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLI-DATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☐ g/cc ☐	CONSOLI-DATED pcf ☐ g/cc ☐		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
1.46	1.47		29.0	93.5	28.5	6.38	10	157	1
1.46	1.50		30.0	76.8	28.6	6.02	20	15[illegible]	2
1.52	1.59		27.4	96.7	24.7	6.00	30	250	2
1.51	1.59		28.2	98.1	24.8	5.20	40	350	3



REMARKS TESTED @ NATURAL MOISTURE

LABORATORY NO. 62442

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: [illegible] | SAMPLE LOCATION: [illegible]

FIELD SAMPLE NO: [illegible] | DEPTH: 13-23' | GEOLOGIC ORIGIN: [illegible]

TYPE OF SAMPLE: [illegible] | TESTED AT: [illegible] | APPROVED BY: [illegible] | DATE: 7-19-79

INDEX TEST DATA

USCS CL; LL 35; PI 16

% FINER (mm): 0.002 24; 0.005 31; 0.074 (#200) 53

G_s (-#4) 2.65; G_s (+#4) _____

STANDARD: γ_d MAX. _____ pcf; w_o _____ %

MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

SPECIMEN DATA

HEIGHT 3.0"; DIAMETER 1.4"

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION REMOLDED FROM AN UNDISTURBED CORE

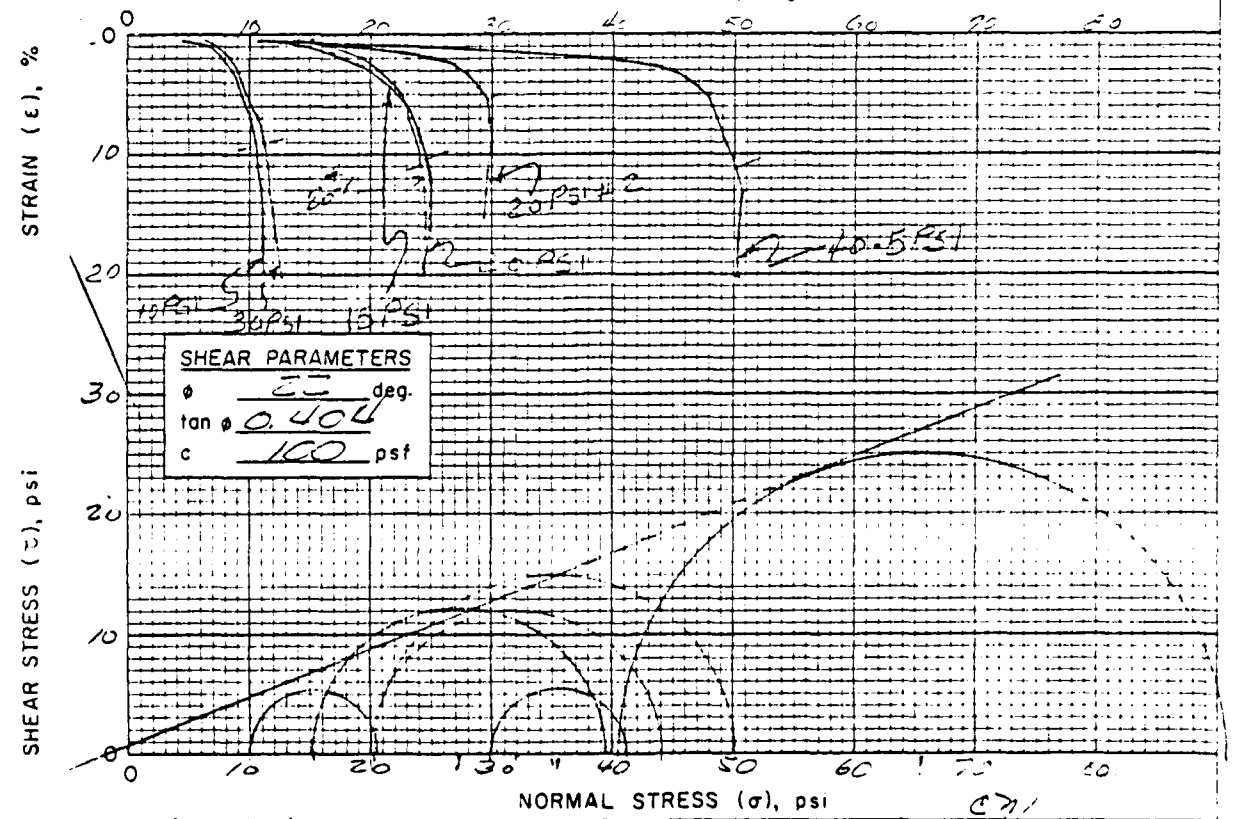
MOLDING MOISTURE _____ %

MOLDED AT _____ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐ CU ☑ $\overline{CU}$ ☐ CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLI-DATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☐ g/cc ☐	CONSOLI-DATED pcf ☐ g/cc ☑		START OF TEST	DEG OF SAT. AT START OF TEST	END OF TEST				
1.53	1.61		28.4	100	25.2	6.13	10	104	9.0
1.51	1.62		27.9	98.0	23.5	6.40	20	80.1	11.6
1.51	1.65		28.9	100	23.7	6.60	30	111	9.6
1.57	1.65		27.1	100	25.3	6.12	15	96.6	10.6
1.57	1.64		26.3	100	23.4	6.30	20 & 2	80.0	5.3
1.54	1.63		25.6	99.2	24.9	6.37	40.5	50.1	11.1



REMARKS Note - Shear parameter by least squares

USDA SCS HYATTSVILLE MD 1980

Form SCS 355A
(Rev. 6-65)

LABORATORY NO 62435

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: CF LIMESTONE LOST MUDDY C-3 MISSOURI
SAMPLE LOCATION: SOUTH C+50 12+00

FIELD SAMPLE NO:
DEPTH: 0-2.0'
GEOLOGIC ORIGIN: ALLUVIUM

TYPE OF SAMPLE: COMPACTED
TESTED AT: SWL - LINCOLN
APPROVED BY: LPD
DATE: 7-19-68

INDEX TEST DATA

USCS CL ; LL 43 ; PI 18
% FINER (mm): 0.002 18 ; 0.005 30 ;
0.074 (#200) 99
G_s (-#4) 2.58 ; G_s (+#4) _____
STANDARD: γ_d MAX. 96.5 pcf; w_o 21.0 %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

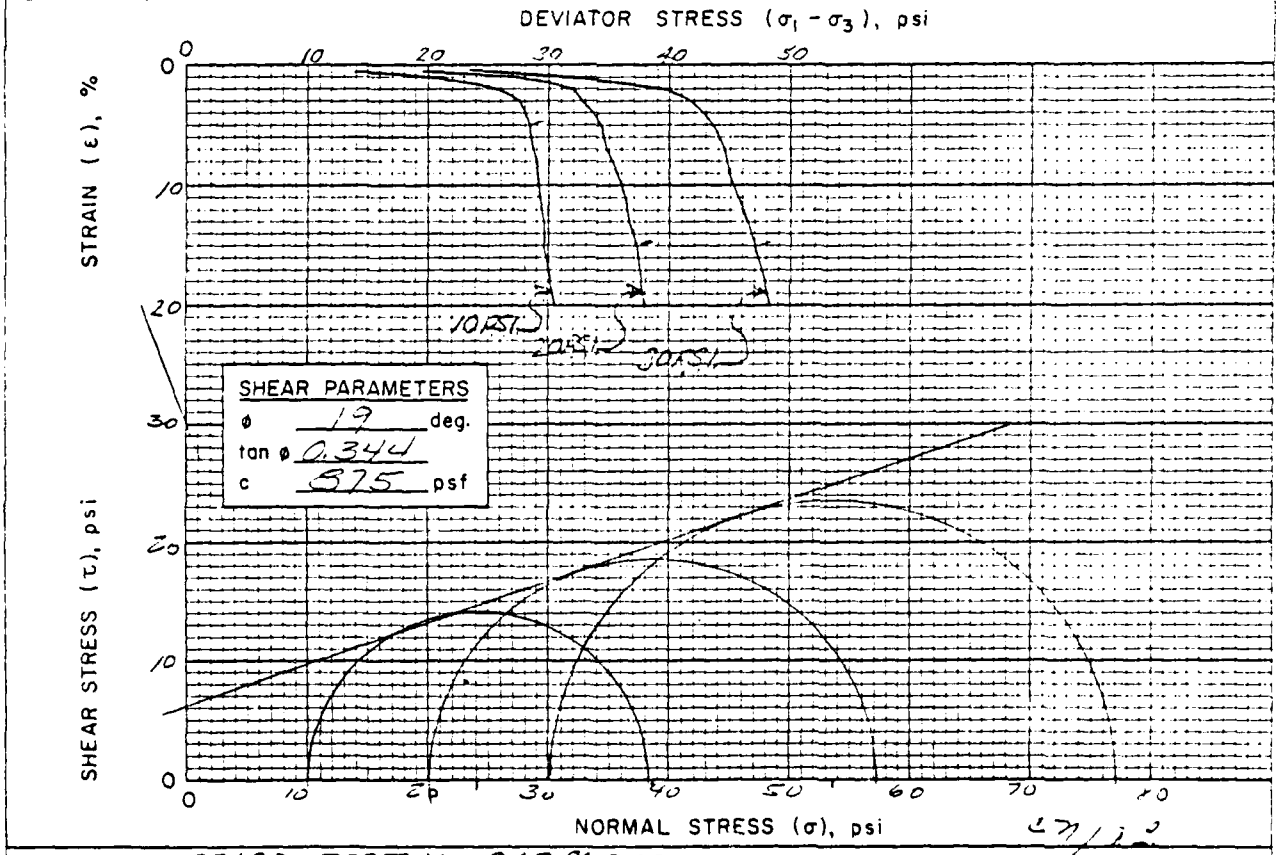
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION STATIC
MOLDED IN 3 LIFTS (SOAKED)
MOLDING MOISTURE 23.4 %
MOLDED AT 94.9 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLI-DATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☒ g/cc ☐	CONSOLI-DATED pcf ☒ g/cc ☐		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
91.7	91.7		27.1	92.5	27.1	6.25	10	25.3	5
91.2	92.3		27.3	91.9	26.5	6.08	20	37.2	15
91.3	93.0		27.1	91.2	25.9	6.32	30	47.0	15



REMARKS AVERAGE TEST γ_d = 94.7 % STD.

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT OR STATE: [illegible] SAMPLE LOCATION: [illegible]

FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN
[illegible]	11.5-13.3'	[illegible]

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]	LPD	[illegible]

INDEX TEST DATA

USCS CH ; LL 54 ; PI 34

% FINER (mm): 0.002 35 ; 0.005 [illegible]

0.074 (#200) 92

G_s (-#4) 2.65 ; G_s (+#4) [illegible]

STANDARD: γ_d MAX. 102.5 pcf; w_o 19.5%

MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

SPECIMEN DATA

HEIGHT 5.0 ", DIAMETER 2.8

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION [illegible]

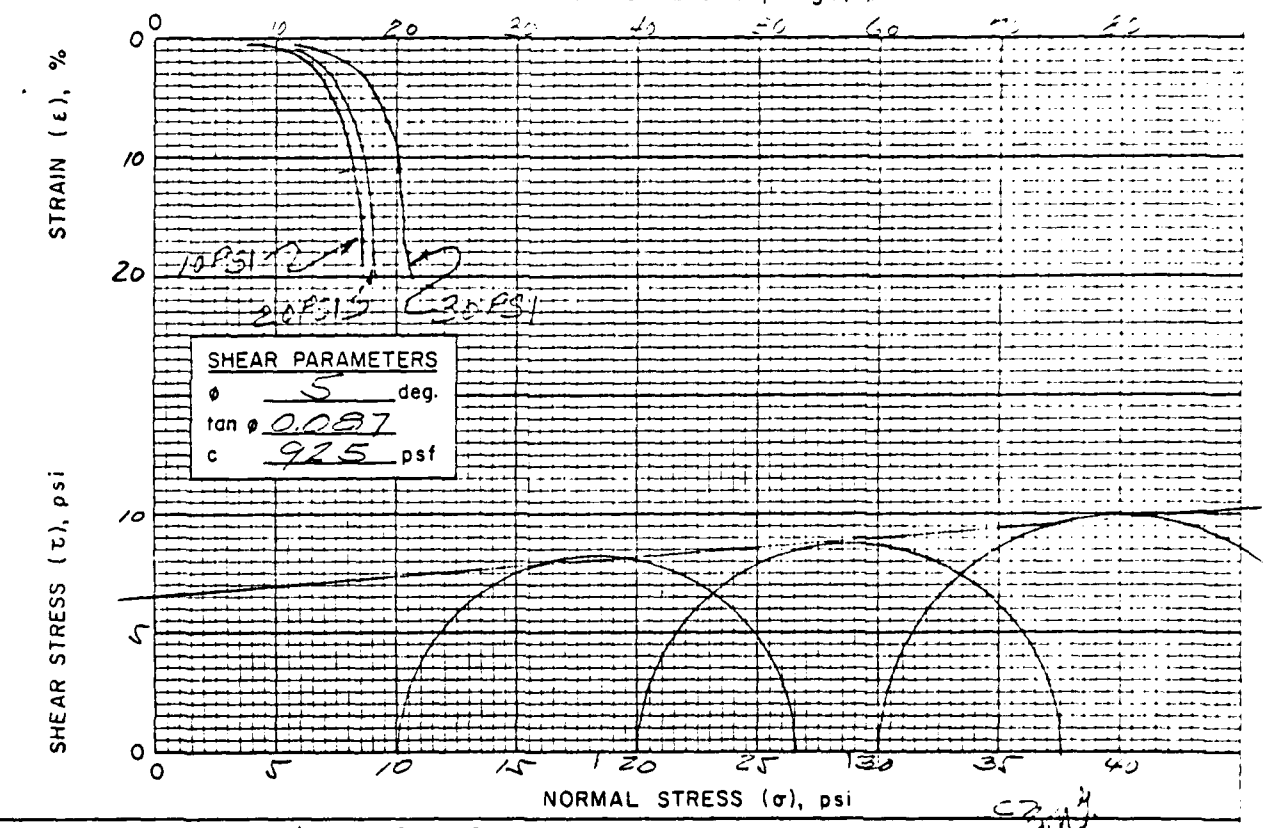
MOLDING MOISTURE 25.6 %

MOLDED AT 95.1 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☐ g/cc ☐	CONSOLIDATED pcf ☐ g/cc ☐		START OF TEST	DEG. OF SAT AT START OF TEST	END OF TEST				
94.1	99.3		20.5	[illegible]	[illegible]	12.0	10	105	11
93.2	[illegible]		[illegible]	[illegible]	[illegible]	12.0	30	175	11
94.3	[illegible]		[illegible]	[illegible]	[illegible]	12.5	50	129	9



REMARKS Average Test rd = 95.1

USDA SCS HYATTSVILLE MD 1980

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT AND STATE: Bridgestone - Lost - Muddy #C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
103.1	Borrow C + 50 12+00	2.0' - 2.0'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CL LL 43 PI 18

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

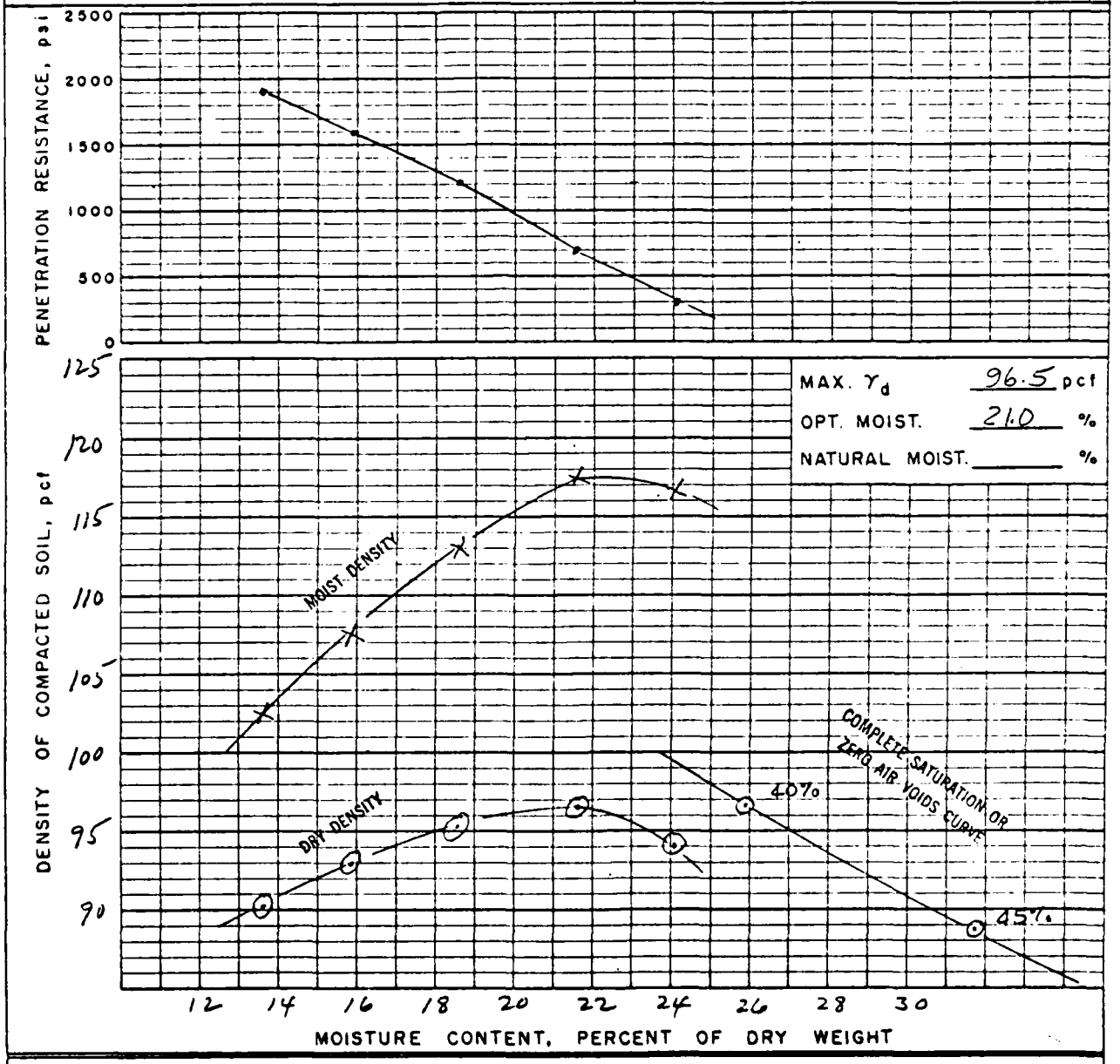
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.58 / PLUS NO. 4 ____

CURVE NO. 1 OF 9

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Sandstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
1032	Borrow, C+50, 12+20	2.0 - 6.0'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CL LL 46 PI 25

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

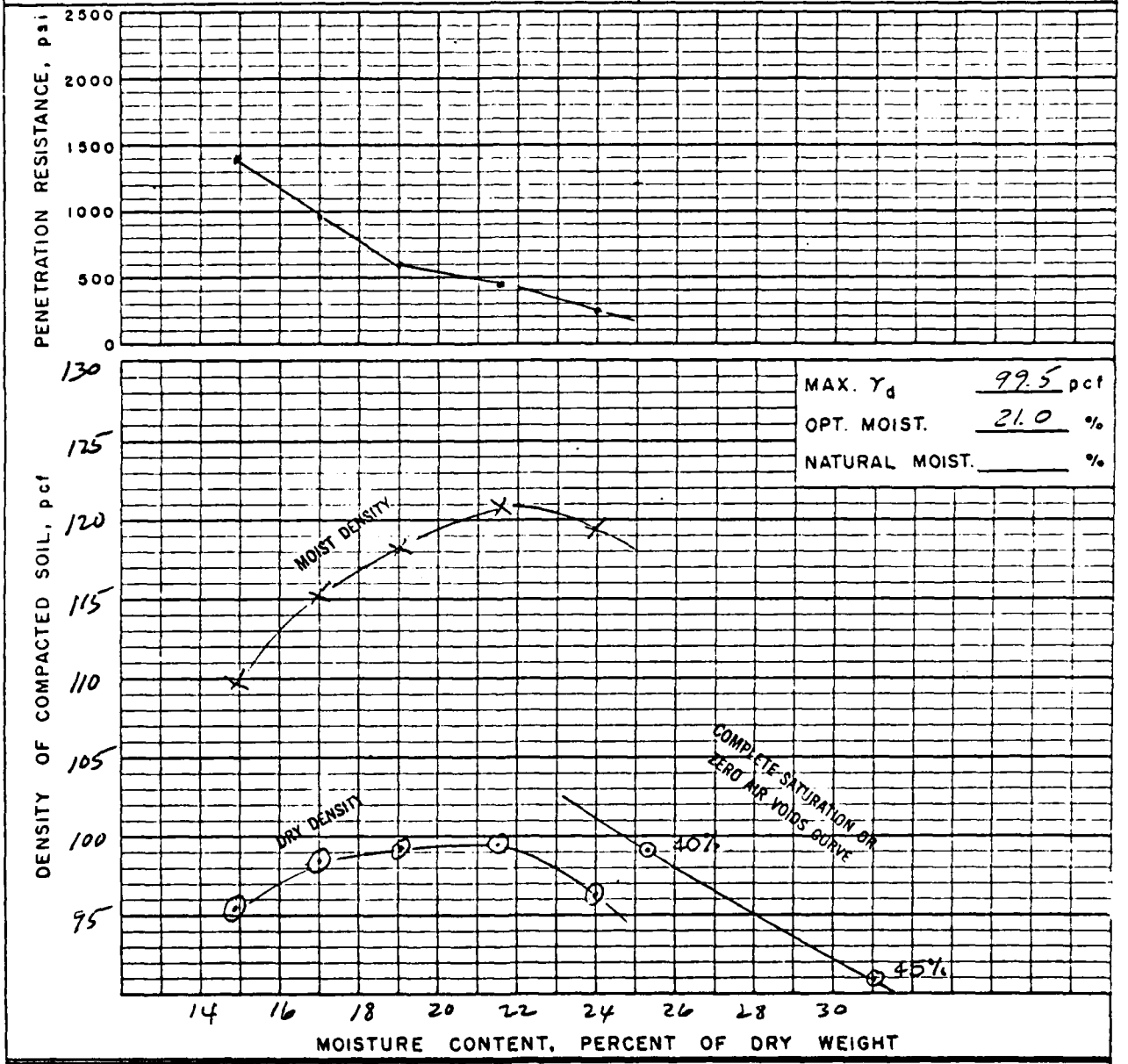
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.64 ; PLUS NO. 4 ____

CURVE NO. 2 OF 9

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Grindstone - Lost - Muddy # C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
105.1	Borrow, E+00, 20+00	2.0 - 4.5'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CH LL 59 PI 38 CURVE NO. 3 OF 9

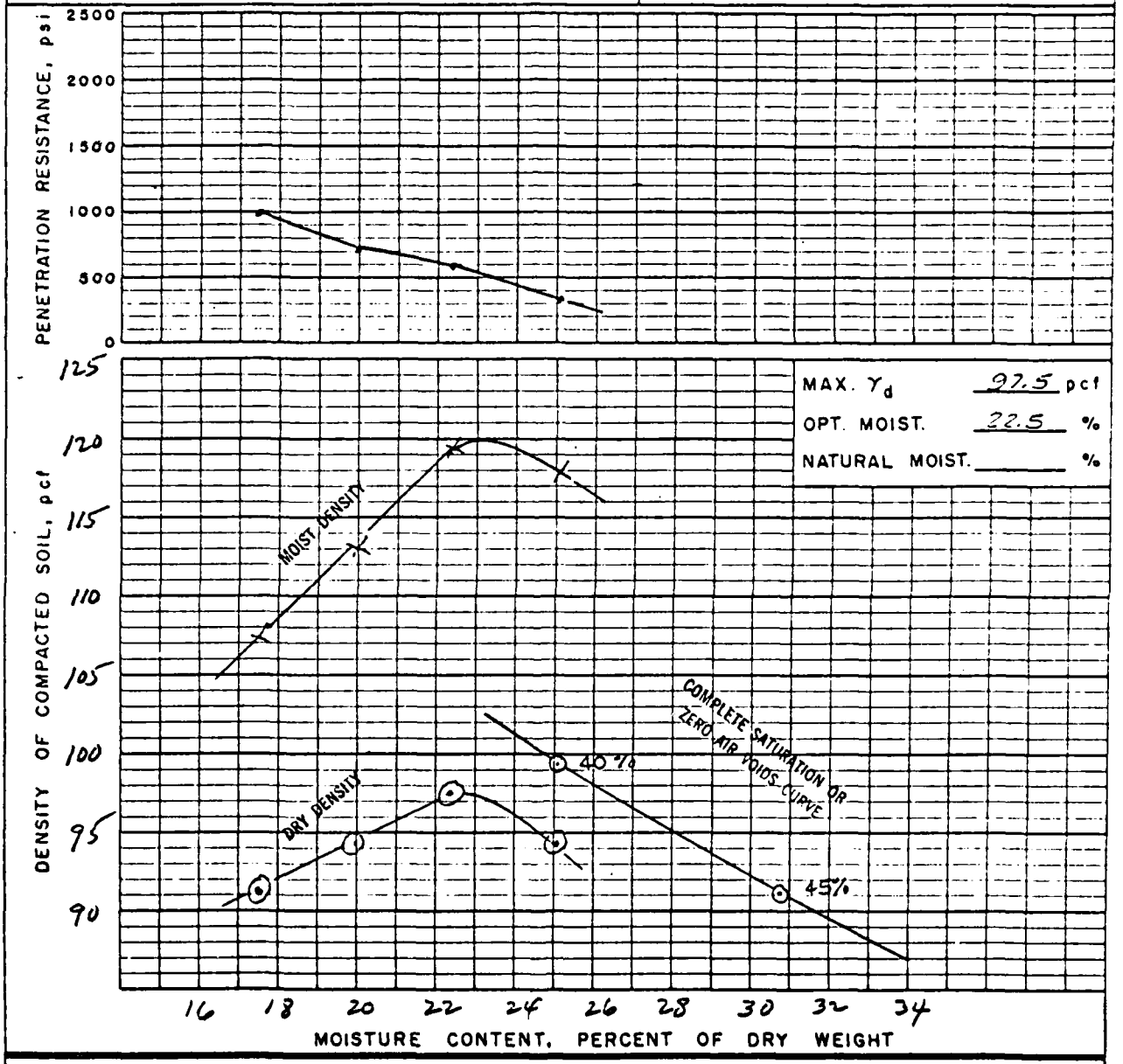
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.65 / PLUS NO. 4 ____

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

FORM SCS-352
REV. 5-65

LABORATORY NO. 67W38

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Grindstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
105.?	Borrow E 100, 20 100	4.5-10.0

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CH LL 54 PI 34 CURVE NO. 4 OF 9

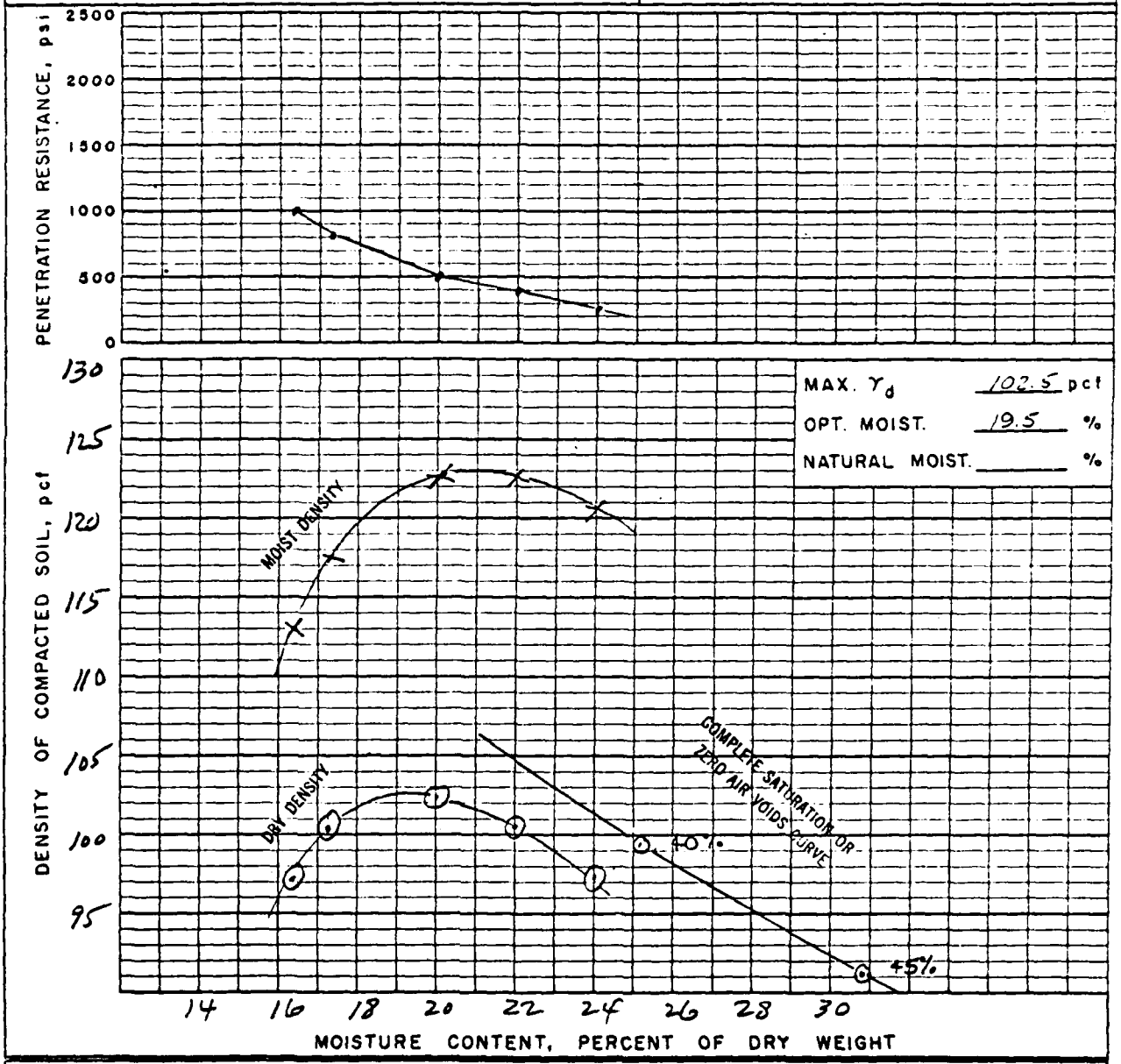
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.65 / PLUS NO. 4 ____

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Grindstone – Lost. Muddy # C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
109.1	Borrow, I+00, Y+00	0.0 – 4.0'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CL LL 48 PI 27 CURVE NO. 5 OF 9

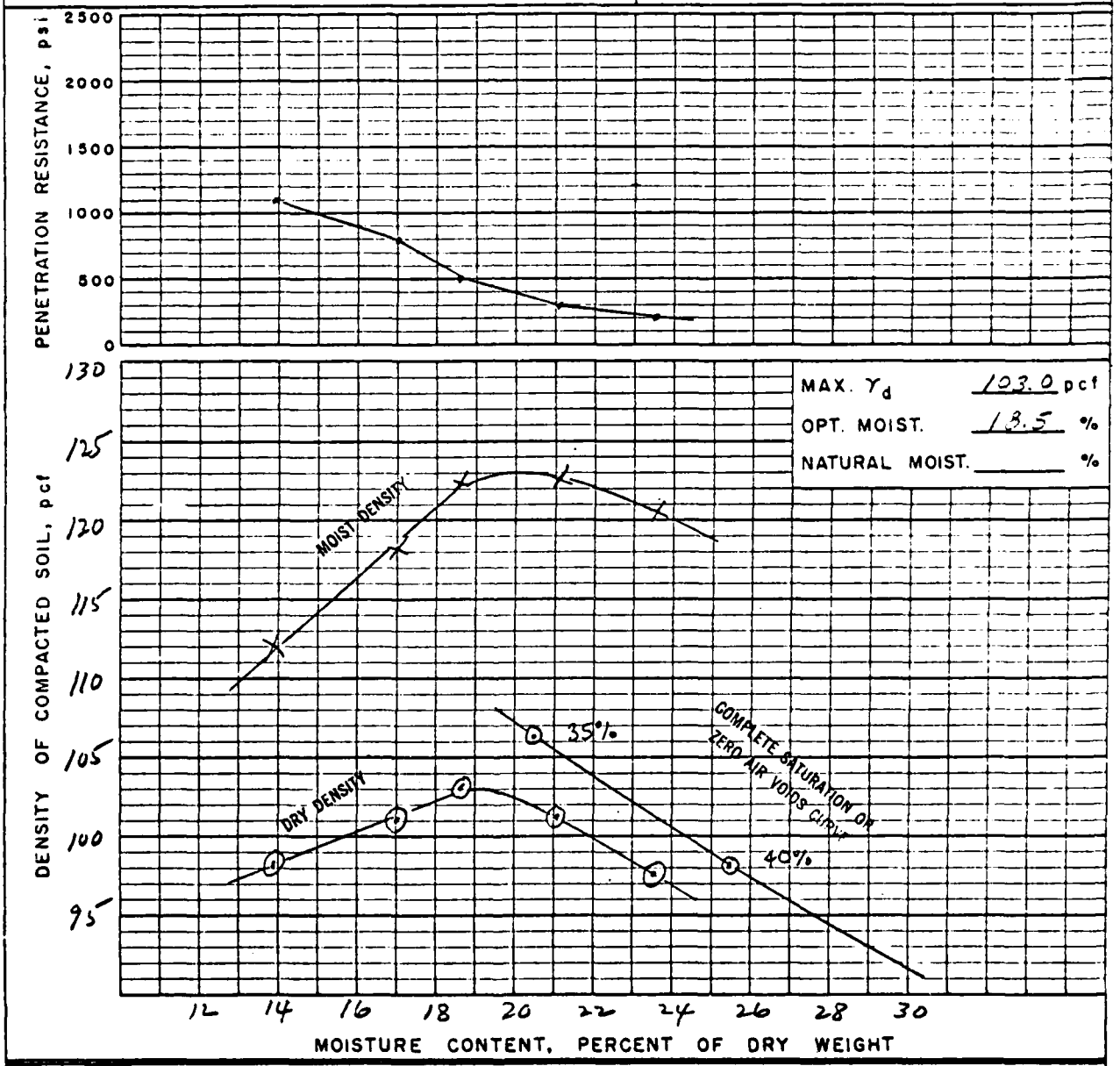
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.62 / PLUS NO. 4 ____

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

6240

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Grindstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
123.2	Borrow, I+00, Y+00	4.0-8.0'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CH LL 51 PI 33

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

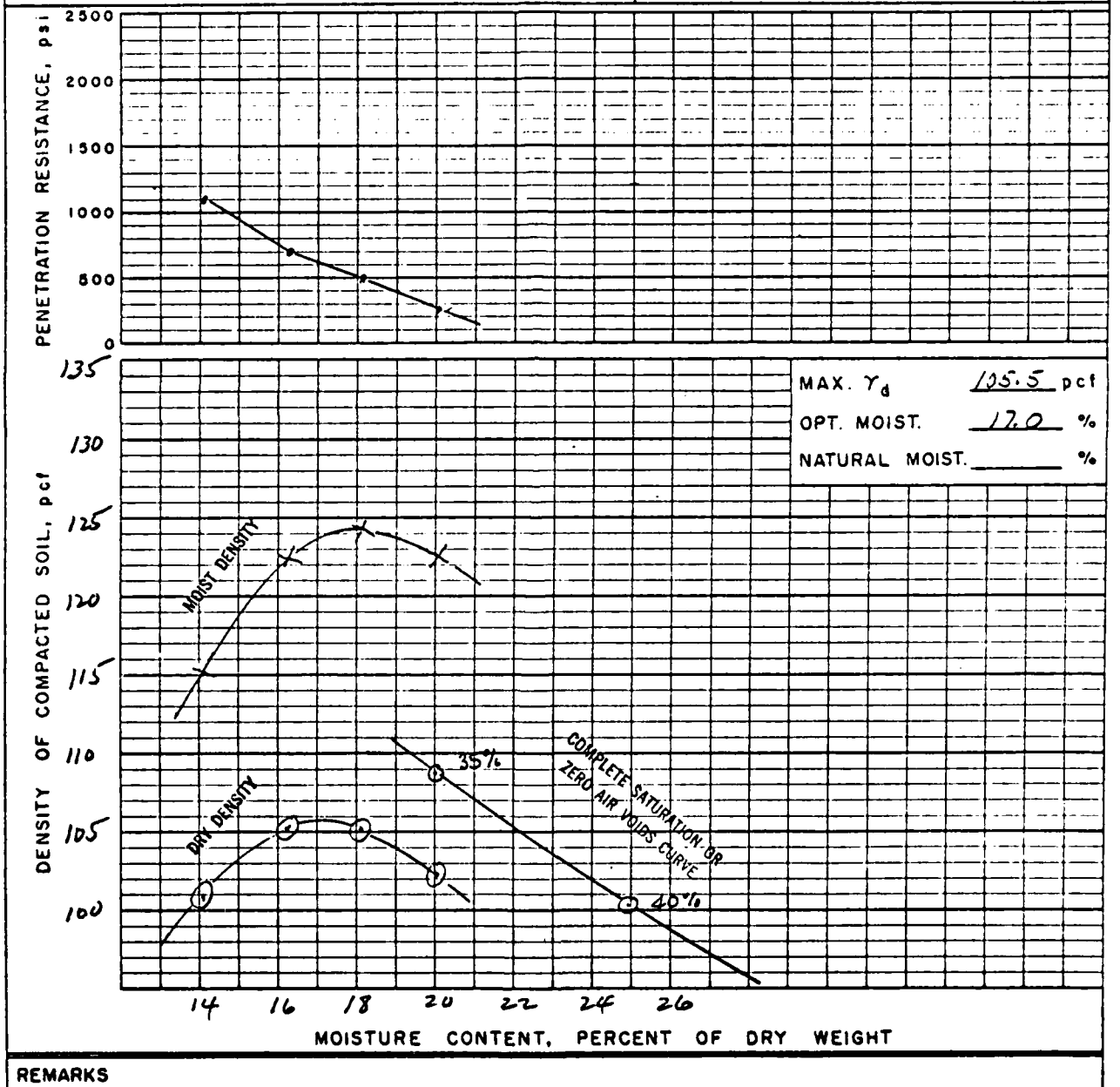
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.68 / PLUS NO. 4 ____

CURVE NO. 6 OF 9

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U.S DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Grindstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
110.1	Borrow, I+00, 22+00	0.0 - 2.5'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN		

CLASSIFICATION CL LL 47 PI 22

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

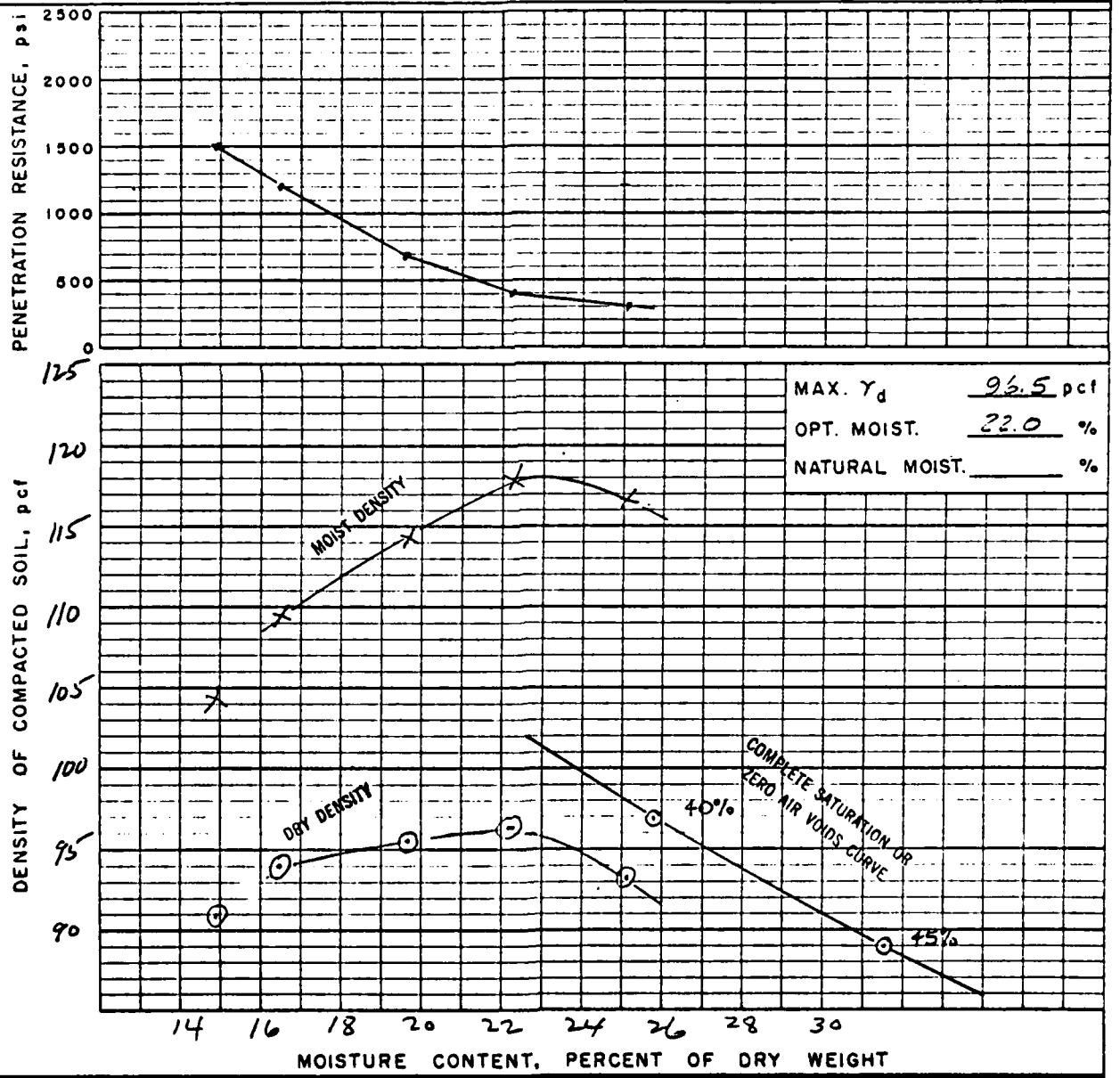
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.59 / PLUS NO. 4 ____

CURVE NO. 7 OF 9

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

FORM SCS-352
Rev. 5-65

LABORATORY NO. GPW42

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Grindstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
110.2	Borrow, I+00, 32+00	2.5'-6.0'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CH LL 57 PI 36

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

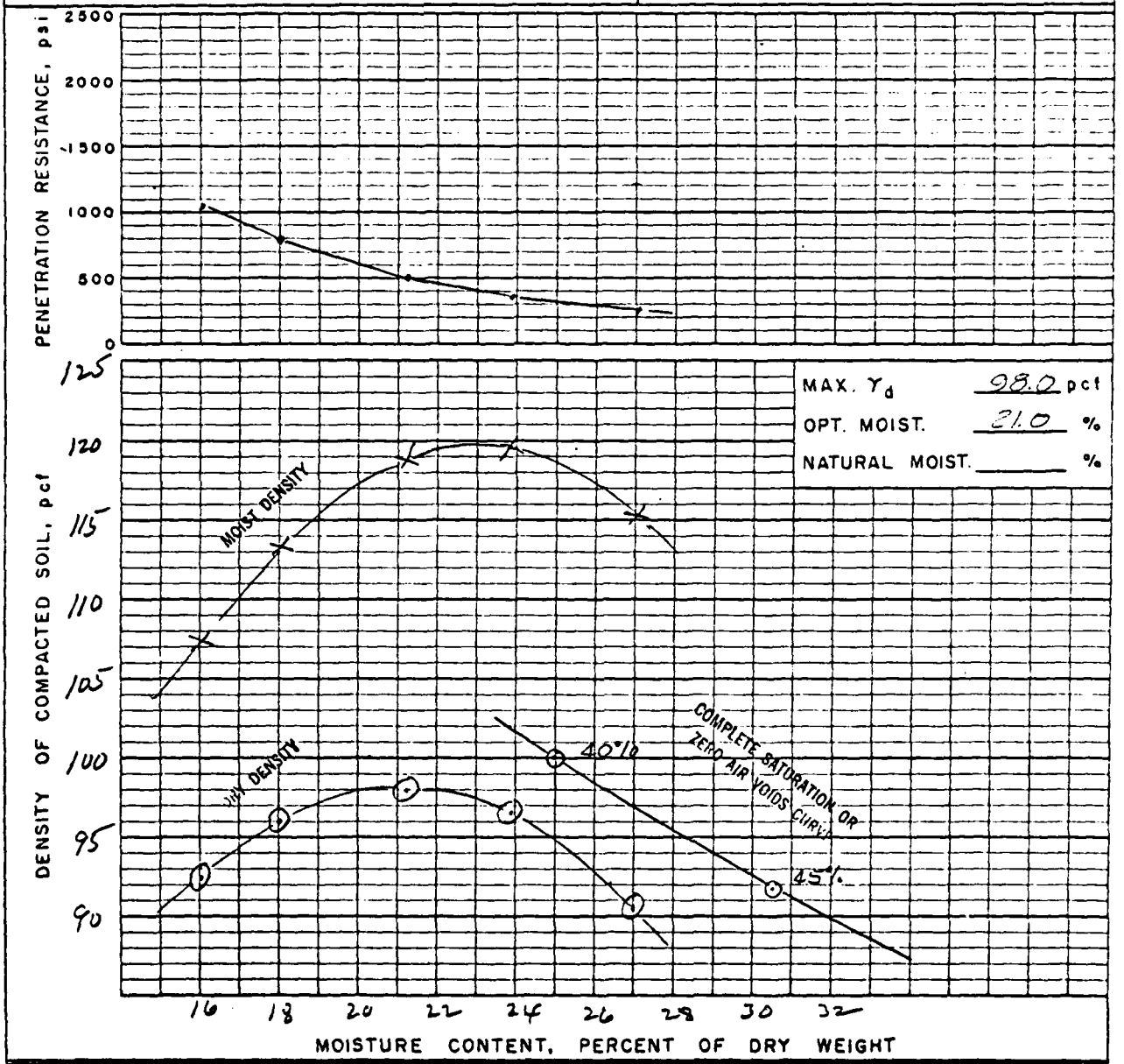
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.67 ; PLUS NO. 4 ____

CURVE NO. 8 OF 9

STD. (ASTM D-698) ☒; METHOD A

MOD (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

FORM SCS-352
(REV. 5-63)

LABORATORY NO. 67-2143

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT & STATE: Grindstone-Lost-Muddy #C-3 Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
110, 3	Borrow, I+00, 22+00	6.0'-9.5'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN	LPD	

CLASSIFICATION CL LL 44 PI 26

CURVE NO. 9 OF 9

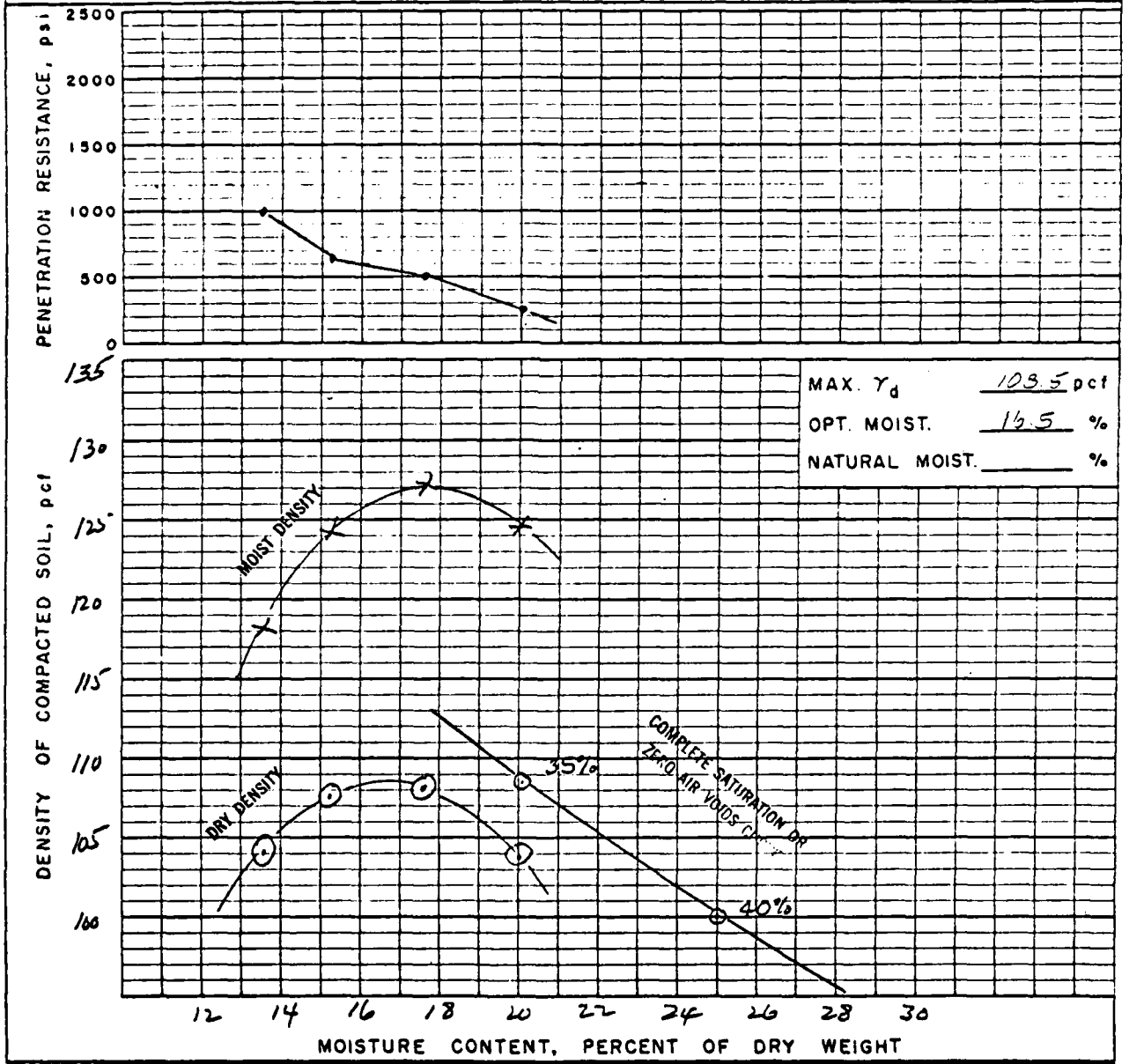
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.67 / PLUS NO. 4 ____

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT | U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE

SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: [illegible] Cost Project, [illegible]

METHOD OF ANALYSIS: Swedish Circle

ANALYZED AT: SMC

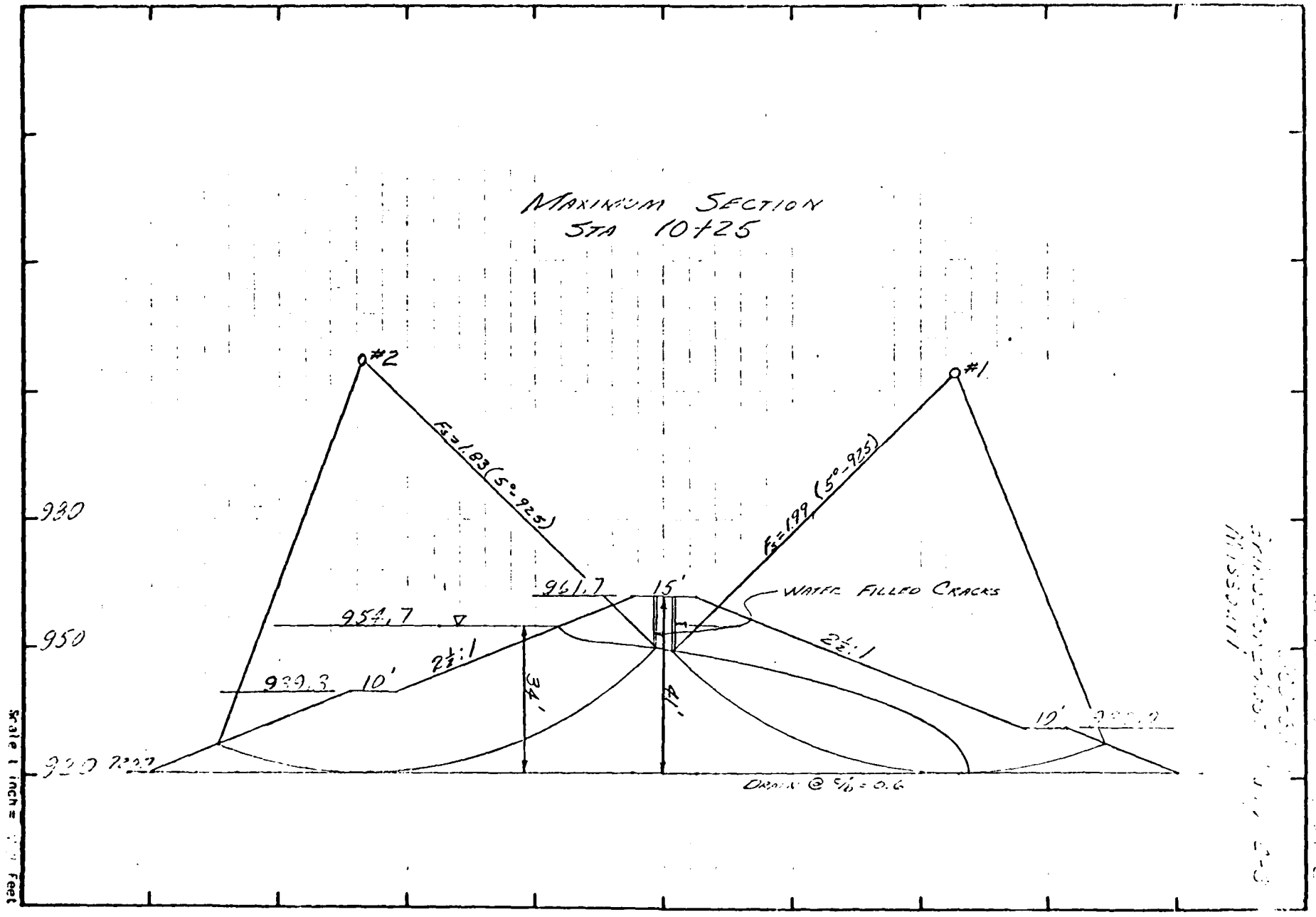
APPROVED BY: [illegible]

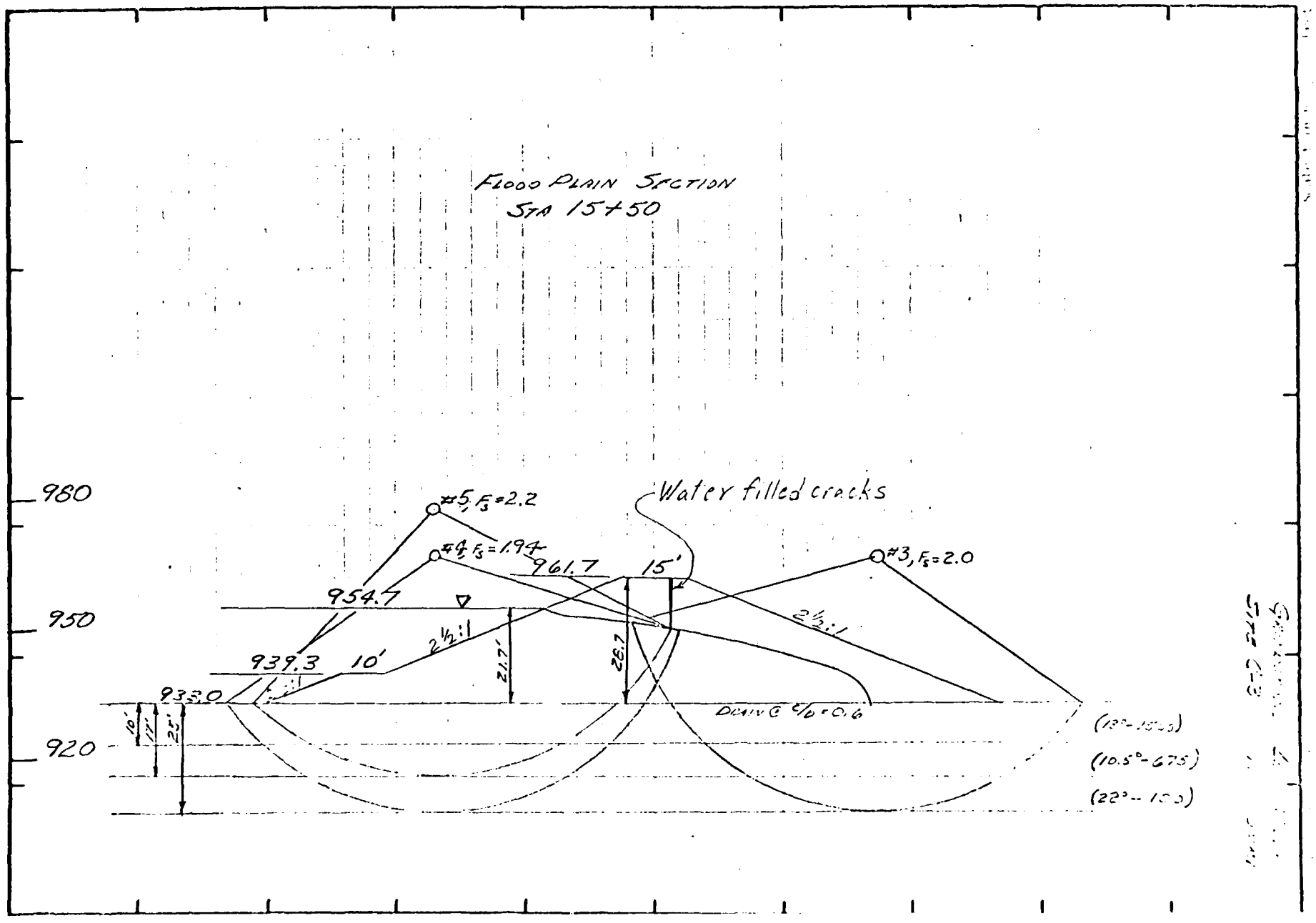
DATE: [illegible]

SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA							REMARKS
		Yd (pcf)	Ym (pcf)	Ysat (pcf)	Ysub (pcf)	ϕ (deg)	tan ϕ	c (psf)	
① Foundation	CL	97.2		121.5	59.0	13.5°	0.240	1500	
② Foundation	CL	93.0		119.5	57.0	10.5°	0.185	675	
③ Foundation	CL	96.0		122.5	60.0	22°	0.404	100	
④ Embankment	CH	97.5	116.5	122.5	60.0	5°	0.087	925	
⑤									
⑥									
⑦									
⑧									

TRIAL NO.		SLOPE	CONDITIONS	F_s
			Maximum Section @ Station 10+25	
			Upstream Berm @ Elev 931.3; Downstream Berm @ Elev. 932.0;	
			Slopes = 2½:1 upstream & downstream; Drain @ c/b = 0.6	
1A	DN	2½:1	Arc Cut From Bottom of Crack Thru Emb. only (5°-925).	1.99
1B	DN	2½:1	Same As #1A with (19°-875)	2.6
2	UP	2½:1	Arc Cut From Bottom of Crack Thru Emb. only (5°-925) Full Drawdown	1.83
			Flood Plain Section Station 15+50	
			Upstream Berm @ Elev 939.3. Slope = 2½:1, upstream & downstream.	
			Drain @ c/b = 0.6	
3	DN	2½:1	Arc Cut From Bottom of Crack 25' into Zoned Foundation. Emb = (5°-925)	2.0
4	UP	2½:1	Arc Cut From Bottom of Crack 25' into Zoned Foundation. Emb = (5°-925) Full D.D.	1.94
5	UP	2½:1	Arc Cut From Bottom of Crack 17' into Zoned Foundation. Emb = (5°-925) Full D.D.	2.2

Sheet 7 of 12

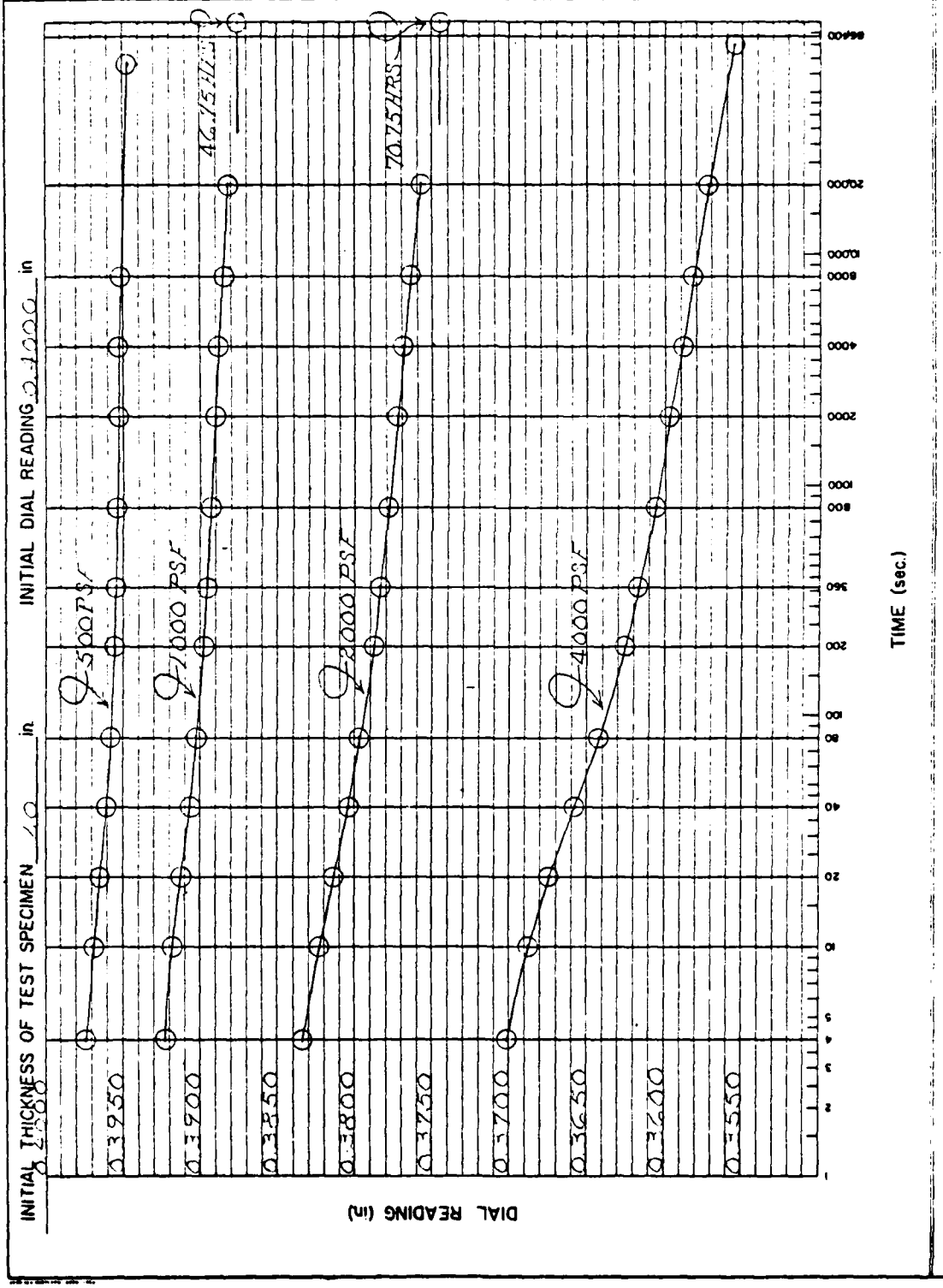

MAXIMUM SECTION
STA 10+25
#2
#1
F_S=1.83 (5°-92.5)
F_S=1.99 (5°-92.5)
961.7
15'
954.7
939.3
10'
2½:1
2½:1
34'
17'
WATER FILLED CRACKS
10'
930
950
Drain @ 9/16 = 0.6


FLOOD PLAIN SECTION
STA 15+50
980
950
920
#5, Fs=2.2
#4, Fs=1.94
#3, Fs=2.0
Water filled cracks
961.7
15'
954.7
939.3
10'
933.0
2½:1
2½:1
21.7'
28.7'
10'
17'
25'
DRAIN @ c/c=0.6
(13°-15°)
(10.5°-6.75)
(22°-10°)

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

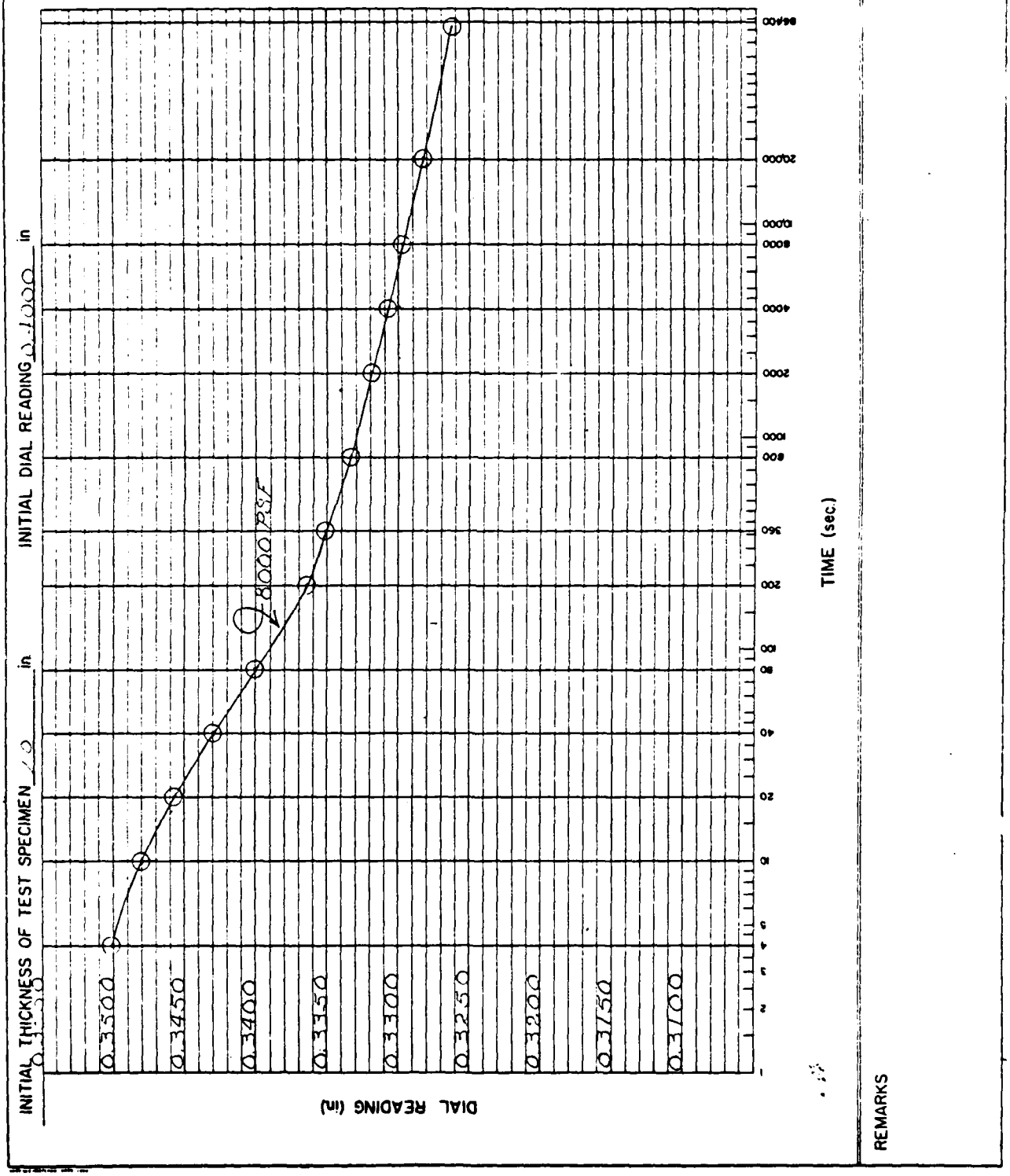
PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]		
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]		



LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE			SAMPLE LOCATION
[illegible]			[illegible]
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
[illegible]	[illegible]		
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
[illegible]	[illegible]		



REMARKS

APPENDIX E

DIVISION III

ENGINEER'S REPORT

USDA - SCS

MAY, 1968

Engineer's Report - Investigation of Dam Site C-3
Grindstone-Lost-Muddy Creek

Harold B. Townsend 5-22-68

CORE TRENCH: Recommended Depth:

Station	Elevation
3:1 End slope	
3+40	953.0
5+50	950.0
7+50	951.0
3:1 End slope - Lt. Emrg. Spw.	
9+90	953.0
10+50	920.0
11+00	920.0
12+00	925.0
13+00	925.0
19+00	930.0
20+00	931.0
21+00	933.0
22+00	936.0
23+00	940.0
23+50	945.0
24+20	961.0

The recommended core trench will provide a good cut off except for the SM and GM materials found below elevation 910.0. This material is covered from 12 ft. to 22 ft. with CL materal and seepage from the pool will be very low. Foundation drains should not be needed to remove seepage from the foundation surface near the toe of the dam, however, the final decision on this can be made after the SCL has completed its tests.

STREAM CHANNEL CLEAN OUT: Stream channel clean out is recommended. It will be about 2 ft. deep in the center of the channel and is generally confined to the existing channel. The extent of the clean out has been shown on the Geologist's field sheets.

SLOPING CHANNEL BANKS: The left channel bank between station 10+00 and 10+50 is covered with timber. The clearing and foundation stripping operation will result in a slope of approximately 2:1. Also, the bank will intersect the dam as a curved surface rather than a flat plane.

USE OF EXCAVATED MATERIALS: With proper scheduling of the construction operations all excavated materials except foundation stripping can be utilized in the dam and emergency spillway (moisture permitting).